Drill Hole No. SH-C01

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Mike Corn
DATE STARTED / FINISHED: 7/21/05 - 7/23/05	DRILL TYPE: BK-81
LOGGED BY: Kagan Rutz and Jeff Riedel	HOLE DIAMETER: 4 1/4" ID Hollow Stem Auger
GROUND SURFACE ELEVATION: 3291.0 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17044064, 919556.8	

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1						Pavement (7" thick).						
								Moist, Light olive brown [2.5Y 5/4], GRAVEL with Silt and Sand, GW-GM, non-plastic, very dense.						
		2												
		3	X			2" SS	89				67			
		4												Advanced auger 3.5-5'.
		5						Moist, Light olive brown [2.5Y 5/3], GRAVEL with Sand, GW, non-plastic, medium dense.						Some organics in tip of sampler.
		6	X			2" SS	67				19			
		7												
		8												
		9												Driller says softer at 8.5'.
		10						Moist, Very dark gray [5Y 3/1], GRAVEL with Sand, GW, non-plastic, medium dense.						
		11	X			2" SS	33				16			
		12						Moist, Very dark gray [10YR 3/1], GRAVEL with Clay and Sand, GW-GC, low plasticity, medium dense.						
		13			X									
		14												
		15						Moist, Dark brown [10YR 3/3], GRAVEL with Clay and Sand, GW-GC, low plasticity, medium dense.						
		16	X			3" SS	89				15			
		17												Auger advances through soft silty gravel from 16.5-20'.
		18												
		19												
		20	X			2" SS	56	Wet, Dark olive brown [2.5Y 3/3], GRAVEL with Clay and Sand, GW-GC, low plasticity, loose.			9			
		21												

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1215 Apple's Way Belgrade, Montana 59714

CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

PROJECT NAME: Milltown Dam

Drill Hole No. SH-C01

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		22	X			2" SS	56	Wet, Dark olive brown [2.5Y 3/3], GRAVEL with Clay and Sand, GW-GC, low plasticity, loose. *(Continued)*			9			Auger advances through silty gravel from 21.5 -25'.
		23												
		24												
		25	X			2" SS	17	Moist, Dark olive brown [2.5Y 3/3], GRAVEL with Clay and Sand, GW-GC, low plasticity, medium dense.			11			
		26												
		27												Advance auger 26.5-30'. Firm and consistent (speed) drilling. No cobbles.
		28												
		29												
		30	X			3" SS	50	Saturated, Dark olive brown [2.5Y 3/3], GRAVEL with Clay and Sand, GW-GC, low plasticity, loose.			9			
▼		31												
		32												Easy augering from 31.5-35'. Water measured at 31.8' on 8/26/05 in piezometer A.
		33												
		34												
		35												Water measured at 34.3' on 8/26/05 in piezometer B. Only gravel recovered in spoon.
		36												
		37	X			3" SS	39	Saturated, Dark olive brown [2.5Y 3/3], GRAVEL, GP, no to low plasticity, loose.			7			Harder drilling at 36.5'. Transition into native alluvium at 36.5'.
		38												
		39												
		40	X			2" SS		Saturated, Dark olive brown [2.5Y 3/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, loose.			6			
		41												
		42												
		43	X			2" SS	39	Saturated, Dark olive brown [2.5Y 3/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, medium dense.			16			Softer drilling at 42.5'. Water measured at
		44												

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C01

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DEPTH (FT)	SAMPLES: DRIVE / UNDISTURBED / BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
45				Saturated, Dark olive brown [2.5Y 3/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, medium dense. *(Continued)*						43.5' on 8/26/05 in piezometer B.
46		3" SS	6	Medium dense, only slough (sand) in sampler- no sample taken- gravels.			11			Advance auger 44-45' through dense matrix of gravel and sand. Pilot bit broke off during augering. Took split spoon sample- could have pushed pilot bit.
47										Water encountered while drilling at 47'.
48										
49										
50				Saturated, Brown [10YR 4/3], SAND with Silt, SP-SM, non-plastic, loose.						Start drilling at 50' on 7/23/05.
51		2" SS	72				6			
52		Shelby	112	Saturated, Light brown [7.5YR 6/3], SILTY SAND, SM, medium to fine grained.	NP	NP		99.6	27.6	Pushed Shelby 17" to refusal.
53				Saturated, Brown [10YR 4/3], SAND with Gravel, SP, non-plastic, medium dense, medium grained. Bottom 3" (GW-GM) Well-graded gravel with silt, low plasticity.						Driller notes gravels at 53.5' when reaming.
54		2" SS	72	Saturated, Brown [10YR 5/3], GRAVEL with Sand, GP, angular, non-plastic, medium dense.			25			Advance 54.5- 55'.
55				Saturated, Brown [10YR 5/3], GRAVEL with Silt and Sand, GW-GM, non-plastic, medium dense, some organics, fines are fine to coarse grained.						Attempted brass liners not good enough to preserve.
56		3" SS	94				28			Advance 56.5-60'. Gravels noted during advance to 60'.
57										
58										
59										
60										Pieces of gravel lodged in nose of SS upon recovery.
61		2" SS	33				28			Advance 61.5-65'. Driller notes sand and gravel on bit as well as gravels during advance.
62										
63										
64										
65				Saturated, Pale brown [10YR 6/3], GRAVEL with Silt and Sand, GW-GM, non-plastic, dense, sand is coarse to medium grained.						3" of slough to start
66		2" SS	33				41			
67										

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C01

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		68						Saturated, Pale brown [10YR 6/3], GRAVEL with Silt and Sand, GW-GM, non-plastic, dense, sand is coarse to medium grained. *(Continued)*						Advance 66.5-70 through gravels.
		69												
		70	X											3" of slough to start
		71	X			2" SS	39				34			
		72												Advance 71.5-75' through gravels.
		73												
		74												
		75				2" SS		Saturated, Pale brown [10YR 6/3], GRAVEL with Silt and Sand, GW-GM, non-plastic, very dense, with quartzite chips.			100			
		76												Advance very very slow; through boulder at 76' and 77.5'
		77												
		78	X			2" SS	39	Saturated, Pale brown [10YR 6/3], GRAVEL with Silt and Sand, GW-GM, non-plastic, dense, angular gravel particles, particles are hard maroon siltstone.			45			77.5': top 11" was slough from hole. Bottom seems to be crushed boulder from auger and SS.
		79	X											
		80			X			Saturated, Brown [10YR 5/3], GRAVEL with Silt and Sand, GW-GM, rounded, non-plastic, medium dense, sand is coarse to medium grained.						Advance 79-80'. Cobbles noted. 80': 3-4" of slough in hole.
		81			X						18			
		82												
		83												
		84												
		85	X					Saturated, Brown [10YR 5/3], GRAVEL with Silt and Sand, GW-GM, non-plastic, medium dense, pieces of quartzite broken up by SS.						85': 6" of slough
		86	X			2" SS	33				27			
		87												
		88												
		89												
		90												

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C01

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		91	X			2" SS	33	Saturated, Pale brown [10YR 6/3], GRAVEL with Sand, GW-GM, non-plastic, dense. *(Continued)*			47			Advance 91-92.5' and drive sample.
		92												
		93	X					Saturated, Pale brown [10YR 6/3], GRAVEL with Sand, GW-GM, non-plastic, medium dense.						
		94				2" SS	33				23			
		95						Total Depth = 94.5'.						
		96												
		97												
		98												
		99												
		100												
		101												
		102												
		103												
		104												
		105												
		106												
		107												
		108												
		109												
		110												
		111												
		112												
		113												

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ADDRESS: 205 Haggerty Lane, Suite 120
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PHONE NUMBER: 406-522-0251

Drill Hole No. SH-C02

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 7/20/05 - 7/21/05	DRILLER: HAZ-Tech Mike Corn
LOGGED BY: Kagan Rutz	DRILL TYPE: BK-81
GROUND SURFACE ELEVATION: 3287.3 ft	HOLE DIAMETER: 4 1/4" ID Hollow Stem Auger
BOREHOLE LOCATION: 17044389.3, 919344.2	HAMMER TYPE: 140# Automatic Trip Hammer

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		0						Asphalt pavement is 5" thick.						
		1						Moist, Brown [10YR 4/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, very dense, 2" angular rocks stuck in spoon.						
		2												
		3	X			2" SS	63				100			Split spoon bouncing on cobble @ 3'.
		4												
		5						Moist, Brown [10YR 4/3], GRAVEL with Clay and Sand, GP-GC, angular to subangular, medium plasticity, very dense.						
		6	X			2" SS	67				100			Bouncing on cobble @ 5.5'.
		7												
		8												
		9												Driller says softer drilling from 9-12'.
		10						Moist, Dark grayish brown [2.5Y 4/2], GRAVEL with Silt and Sand, GP-GM, subangular to rounded, non-plastic, very dense.						
		11	X			2" SS	100				65			
		12												
		13												
		14												
		15						Moist, Brown [10YR 4/3], GRAVEL with Silt and Sand, GP-GM, subrounded, no to low plasticity, loose.						
		16	X			2" SS	44				6			Advanced auger 16.5-20' through gravels with sand and silt.
		17												
		18												
		19												
		20												
		21	X			2" SS	11				6			1.5" subangular gravel plugged sampler.

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C02

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22	X			2" SS	11	Moist, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, subangular to rounded, no to low plasticity, loose. *(Continued)*			6			Advanced auger 21.5-25' through gravels.
		25	X			2" SS	11	Moist, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, subangular to subrounded, no to low plasticity, loose.			7			Advanced auger 26.5-30'. Driller says softer drilling.
		30	X			2" SS	22	Moist, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, subangular to subrounded, low plasticity, medium dense.			15			30'; Sample recovered only gravel- no fines. Advanced auger 31.5-35'. Driller says soft starting at 32'.
		35	X			2" SS	89	Moist, Brown [10YR 5/3], SAND with Clay, SP-SC, low to medium plasticity, loose, sands are fine to very fine grained.			8			
		37	X			3" SS	89	Moist, Brown [10YR 4/3], SAND with Silt, SP-SM, non-plastic, loose, no organics, sand is fine grained.			5			Attempt a 3" split spoon with brass liners at 36.5'.
		38	X			2" SS	100	Moist, Brown [10YR 5/3], SAND with Silt and Gravel, SP-SM, non-plastic, medium dense, sand is fine grained.			17			Gravel in end of sampler.
		40	X			2" SS	53	Moist to wet, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, very dense.			100			No shelby tube attempted- no fine-grained sediments encountered. Native alluvium starting @ 39.5'. Advanced auger 41-45' through dense matrix of gravel. Ground water encountered at 42' while drilling.

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C02

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45						Moist to wet, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, very dense. *(Continued)*						Water level measured @ 43.5' on 8/26/05 in piezometer B.
46	X			2" SS	33	Saturated, Pale brown [10YR 6/3], GRAVEL with Silt and Sand, GP-GM, subangular to subrounded, non-plastic, medium dense, sand is medium grained, gravels subangular to subrounded with inclusions of very fine light yellow sand.			29			
47												Advanced auger 46.5-50' through gravels.
48												
49												
50						Saturated, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, subangular to subrounded, non-plastic, medium dense.						
51	X			2" SS	44				30			
52												Advanced auger 51.5-55' through gravels.
53												
54												
55												Gravel is subangular to angular.
56	X			2" SS	61				15			
57												Advanced auger 56.5-60'. Driller says very hard drilling.
58												
59												
60						Saturated, Brown [10YR 5/3], GRAVEL with Silt and Sand, GP-GM, angular, non-plastic, medium dense, sand is medium to coarse grained.						
61	X			2" SS	28				30			
62												Advanced auger 61.5-65' through dense matrix of gravel and sand. Driller says very hard drilling at 62'.
63												
64												
65												Driller says material went incrementally bouncing on a cobble.
66	X			2" SS	56				100			
67												

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C02

WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		68						Saturated, Pale brown [10YR 6/3], GRAVEL with Silt and Sand, GP-GM, non-plastic, very dense,						Advanced auger 66.5-70' through gravel.
		69												
		70												
		71	X			2" SS	0	Loose, no recovery, slough in hole. *(Continued)*			7			
		72	X			2" SS		Saturated, Grayish brown [2.5Y 5/2], GRAVEL with Sand, GP, non-plastic, medium dense, no recovery (split spoon sample @ 70'), slough in hole.			30			
		73												
		74												
		75						Saturated, Brown [10YR 5/3], GRAVEL with Sand, GP, non-plastic, very dense.						
		76	X			2" SS	56				56			
		77												Advanced auger 76.5-80' through very dense matrix of gravel and sand.
		78												
		79												
		80						Saturated, Pale brown [10YR 6/3], GRAVEL with Clay and Sand, GP-GC, subangular, low to medium plasticity, very dense.						Possibly decomposed bedrock- angular gravel
		81	X			2" SS	39				65			
		82	X			2" SS	50	Saturated, Pale brown [10YR 6/3], GRAVEL with Clay and Sand, GP-GC, medium to high plasticity, dense, appears to be a shale.			31			
		83												
		84												
		85						Saturated, Pale brown [10YR 6/3], GRAVEL with Clay and Sand, GP-GC, dense, low plasticity because of coarse sand sized clasts, fines may have medium plasticity without clasts.						Possibly decomposed bedrock.
		86	X			2" SS	50				41			
		87												
		88												
		89												
		90												

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PROJECT NAME: Milltown Dam

Drill Hole No. SH-C02

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		91	X			2" SS	50	Saturated, Pale brown [10YR 6/3], GRAVEL with Sand, GP, non-plastic, dense. *(Continued)*			33			Advanced auger 91.5-93'. Attempt to advance auger 45 minutes with no advancement at 93'
		92												
		93	X			2" SS	62	Saturated, Brown [10YR 4/3], GRAVEL with Sand, GP, subangular, non-plastic, very dense, possible bedrock at 93'.			100			Start drilling at 93' on 7/21/05.
		94						Total Depth = 94'.						
		95												
		96												
		97												
		98												
		99												
		100												
		101												
		102												
		103												
		104												
		105												
		106												
		107												
		108												
		109												
		110												
		111												
		112												
		113												

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CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
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Drill Hole No. GC-C01

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Chris Peterson
DATE STARTED / FINISHED: 4/5/05 - 4/5/05	DRILL TYPE: CME-850
LOGGED BY: Ryan Norkoli	HOLE DIAMETER: 5" Casing
GROUND SURFACE ELEVATION: 3238.3 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17043795.4, 918610.4	

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		1				3" SS	1	Saturated, Very dark gray [10YR 3/1], SAND, SP, no to low plasticity, sands medium-grained, organics and wood debris present, loose from 1.5-3.5'.			5			Wood debris clogged top of split spoon. Medium grained sand recovered on wood.
		2												
		3				Shelby	40		NP 51	NP 29			31.76	3.5-5': Sand visible in drill cuttings. Driller noted gravels while advancing tricone bit.
		4				3" SS	5	Saturated, Very dark gray [10YR 3/1], SILTY SAND with Gravel, SM, subangular to subrounded, non-plastic, medium dense, gravels maximum diameter 1/2", sands fine to medium-grained.			13			
		5												5-6.5': High blow counts in this interval may be due to woody debris. Rubber debris present.
		6				3" SS	50	Saturated, Black [10YR 2/1], ORGANIC SILTY SAND, SM, non-plastic, very dense, contains 30-40% fibrous organics (woody debris, roots, and stems), trace rubber.			100			
		7				3" SS	25	Saturated, Very dark gray [10YR 3/1], GRAVEL with Sand, GP, non-plastic, very dense, contains 15-20% organics and woody debris, gravels are fractured, multi-colored, subrounded to a 2" maximum diameter.			100			6.5-8': Sand present in cuttings. High blow counts could be from rock which appears to be freshly fractured.
		8												
		9												
		10												
		11						Saturated, Very dark gray [10YR 3/1], SILTY GRAVEL with Sand, GM, non-plastic, medium dense, gravels are multi-colored, subrounded to rounded with a 1.5" diameter.						
		12				3" SS	5				22			11.5-13': Sand present in cuttings.
		13												
		14												
		15						Mostly dark grey argillite with some maroon tones. Bedding mostly indistinct. One measurement @ 15 degrees. Fractures contain mostly calcite with some minor rust-color staining and minor maroon clay. Fractures are horizontal to near vertical and spaced 0-2.5".						Driller notes bedrock @ 14.5'
		16				3" SS	0				100			
		17												17'-20.5'; RQD = 0
		18												The interval from 16.5-17' and 20-20.5' is mostly crushed to intensely fractured.
		19				Core	90							There is a moderate amount of 75 degree to vertical fracturing at 18'. The majority of fractures dip between 20 and 28 degrees.
		20												
		21				Core	80							

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CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

PROJECT NAME: Milltown Dam

Drill Hole No. GC-C01

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22						21.5-26.5': Fractures horizontal to 60 degrees spaced 0-3". Thin fractured quartz vein at 22.5', rubble zone at 25.5-26.5'.						21.5'-26.5'; RQD = 0
		23												
		24				Core	80							
		25												
		26						26.5-31.5': Fractures spaced 0-5", horizontal to near vertical quartz vein at 29.5'.						26.5'-31.5'; RQD = 15
		27												The 26.5'-31.5' interval is intensely to moderately fractured and averages closely fractured.
		28												
		29				Core	90							
		30												
		31						31.5-35.5': Fractures mostly horizontal with some vertical fractures. Spacing of fractures 0-9".						
		32												31.5'-35.5'; RQD = 41
		33												
		34				Core	100							
		35												
		36						Total Depth 35.5'.						
		37												
		38												
		39												
		40												
		41												
		42												
		43												
		44												

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Drill Hole No. GC-C02

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 4/4/05 - 4/4/05	DRILLER: HAZ-Tech Chris Peterson
LOGGED BY: Ryan Norkoli	DRILL TYPE: CME-850
GROUND SURFACE ELEVATION: 3243.4 ft	HOLE DIAMETER: 5" Casing
BOREHOLE LOCATION: 17043856.2, 918610.4	HAMMER TYPE: 140# Automatic Trip Hammer

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1				3"SS	10	Saturated, Very dark gray [10YR 3/1], SILTY GRAVEL with Sand, GM, non-plastic, medium dense, gravels rounded to subrounded to 1.5" diameter.			22			
		2				3"SS	20	Saturated, Very dark gray [10YR 3/1], SAND, SP, non-plastic, loose to medium dense, woody and fibrous organics present, fine to medium grained sand.			12			19 blows from wood debris. Nail wood frags organics present.
		3				3"SS	40	Saturated, Very dark gray [10YR 3/1], SILTY SAND, SM, non-plastic, loose, woody and fibrous organics present, sands fine to medium-grained, uniform.			10			
		4												
		5				3"SS	2	Saturated, Dark gray [10YR 4/1] Very dark gray [10YR 3/1], SAND with Gravel, SP, non-plastic, loose to very loose, gravels multi-colored, subrounded to 1" maximum diameter, wood, nails, and organics present at 4.5-6', abundant organics 6-7'.			2			Sands present in drill cuttings.
		6												
		7				3"SS	80				9			
		8				3"SS	80	Saturated, Black [10YR 2/1], SILTY SAND, SM, non-plastic, loose, many organics present. Saturated, Very dark gray [10YR 3/1], SAND, SP, non-plastic, loose, fine-grained, uniform.			4			Many organics present (7-7.5').
		9						Saturated, Dark gray [10YR 4/1], SILT, ML, medium plasticity, soft.						
		10				Shelby	100	Saturated, Very dark gray [10YR 3/1], SAND, SP, non-plastic, loose, sands fine-grained, uniform.	NP	NP		86.4 85.7 93.7	14.55 19.17 18.48	CU Triaxial
		11						Saturated, Dark gray [10YR 4/1], SANDY SILT, ML, low plasticity, loose, sands fine-grained, uniform.						Pocket Penetrometer @ 11': 0.28 tsf
		12				Shelby	70							
		13						Saturated, Very dark gray [10YR 3/1], GRAVEL with Clay and Sand, GP, subangular to subrounded, non-plastic, very dense, gravels multi-colored, fractured pieces to a 1" maximum diameter.						Blow count: 2nd interval 70 blows; 3rd interval 76 blows advanced spoon 1".
		14				3"SS	0				100			
		15				3"SS	0				100			Driller states drilling in gravels with sand @14 ft.
		16												
		17	X			3"SS	70				100			
		18												
		19												
		20												
		21												

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Bozeman, Montana 59715	
PHONE NUMBER: 406-522-0251	

PROJECT NAME: Milltown Dam

Drill Hole No. GC-C02

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22				3"SS	0	Very finely laminated layers of dark grey, maroon, and light grey argillite and siltite (light grey) with soft sediment deformation. Minor calcite fracture fill (up to 1mm separation) with minor iron oxide staining. General bedding dip of 23 degrees. Primary fracture dips are in the 10-15 degree range. Secondary, still abundant fractures occur vertically and in the area of 40 degrees. Primarily intensely to closely fractured with some crushed intervals throughout.			100			Driller states bedrock encountered @ 21'. Begin coring at 22'. 22'-23': RQD = 0
		23					90							
		24						23-28': Fractures spaced 1/2 - 6" and inclined from horizontal to vertical.						23'-28': RQD = 22
		25					100							
		26												
		27												
		28						28-33': Highly fractured reduced to rubble at 29.5' and 32-33'. Fractures horizontal to vertical and spaced 0-3".						28'-33': RQD = 0
		29												
		30					90							
		31												
		32												
		33						33-35.5': Highly fractured on 0-1" spacing from horizontal to vertical.						33'-35.5': RQD = 0
		34					95							
		35						35.5-38': Rubble zone 1/4 - 1" fragments from 35.5-36.5'. 36.5-38' fractured on 0-1/2" spacing.						
		36												35.5'-38': RQD = 0
		37					80							
		38						38-43': Fracture spacing 0-9". Rubble zone 38-39'. Fractures horizontal to vertical with two thin quartz veins near 42'.						38'-43': RQD = 43
		39												
		40												
		41					70							
		42												
		43						Total Depth 43'.						
		44												

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Drill Hole No. GC-C04

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Chris Peterson
DATE STARTED / FINISHED: 3/31/05 - 3/31/05	DRILL TYPE: CME-850
LOGGED BY: Ryan Norkoli	HOLE DIAMETER: 5" Casing
GROUND SURFACE ELEVATION: 3246.0 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17040905.4, 918565.9	

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1	X			3"SS	100	Saturated, Very dark grayish brown [2.5Y 3/2], SAND, SP, non-plastic, loose to very loose, sand is fine to medium grained.	NP	NP	3		30.98	consolidation test
		2	X			3"SS	100				9	83.3	28.01	
		3	X			3"SS	5	Saturated, Dark greenish gray [5GY 4/1] Pale olive [5Y 6/4], GRAVEL with Sand, GP, non-plastic, very dense, color transition in this interval from the primary color to Brown to the secondary color, medium to coarse grained from 7.5-9', sand fraction from 12.5-13.5' fine to medium grained, becomes fine to very fine silty sand with gravel 13.5-14'.			38			
		4	X											
		5	X			3"SS	60				79			
		6	X											
		7	X											
		8	X			3"SS	70				60			
		9	X											
		10												Driller reports boulder from 10-11'.
		11												
		12												
		13	X			3"SS	90				73			
		14						Saturated, Yellowish brown [10YR 5/8], GRAVEL with Sand, GP, non-plastic, very dense, fine to medium grained gravels that are rounded and multi-colored.						Driller reports dense gravels from 14-17.5'
		15												
		16												
		17												
		18	X			3"SS	70				62			
		19	X											
		20												Driller reports dense gravel.
		21												

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C04

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22						Saturated, Yellowish brown [10YR 5/8], GRAVEL with Sand, GP, non-plastic, very dense, fine to medium grained gravels that are rounded and multi-colored. *(Continued)*						
		23	X					Saturated, Light olive brown [2.5Y 5/6] Strong brown [7.5YR 5/8], CLAYEY GRAVEL with Sand, GC, low plasticity, very dense, secondary color.						
		24	X			3"SS	65				93			
		25												
		26												
		27												Very slow drilling advanced. Tried coring with no recovery and encountered fine sands.
		28	X			3"SS	50	Saturated, Brown [10YR 5/3], GRAVEL with Sand, GP, non-plastic, very dense.			67			
		29												
		30						Saturated, Light gray with pink, SILTY SAND, SC-SM, non-plastic, fine grained with lenses of fine to coarse grained sand.						
		31												
		32												
		33												
		34												
		35												
		36												
		37												
		38												
		39			X			Light to dark pink, sample consists of angular fragments of 1" sized quartzite gravels, very dense, tough drilling.						Bedrock encountered @ 39'.
		40												
		41												
		42												
		43						Total Depth 43'.						
		44												

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Drill Hole No. GC-C06

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Chris Peterson
DATE STARTED / FINISHED: 4/3/05 - 4/3/05	DRILL TYPE: CME-850
LOGGED BY: Ryan Norkoli	HOLE DIAMETER: 5" Casing
GROUND SURFACE ELEVATION: 3249.5 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17043754.4,918647.3	

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DEPTH (FT)	SAMPLES: DRIVE / UNDISTURBED / BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
1			0	Suspect Gravel, GP.			19			Rock clogged bit. No recovery.
2		3"SS	60	Saturated, Very dark gray [10YR 3/1], GRAVEL with Sand, GP, subangular, low to medium plasticity, very dense.			86			Probably human introduced fill gravels.
3		2.5" BL		Saturated, Dark gray [10YR 4/1], SILTY GRAVEL with Sand, GM, subangular, As above gravels.			29			
4		3"SS	25	Saturated, Dark gray [10YR 4/1], GRAVEL with Sand, GP, non-plastic, dense to loose, intact gravels rounded to subrounded to 1" maximum diameter, fractured gravels to 1.5" diameter.			37			
5		3"SS	1				7			Sand in cuttings. Driller thinks this may be sandy gravels from 4.5-6'.
6				Saturated, Very dark gray [10YR 3/1], SILTY GRAVEL with Sand, GM, non-plastic, loose, gravels subrounded to subangular to 3/4" maximum diameter, sands medium-grained, wood debris in sampler.						
7		2"SS	15				6			
8				Saturated, Very dark gray [10YR 3/1], SAND, SP, loose to very loose, sands fine to medium-grained, uniform, medium to coarse-grained toward bottom of interval.						
9		2"SS	20				4			
10										Driller felt gravels while advancing sampler through this interval.
11		2"SS	5				8			
12				Saturated, Very dark gray [10YR 3/1], ELASTIC SILT, MH, high plasticity, very soft, 13.5-14' contains lenses of silty sand with organics.						
13		2"SS	60		53	35	2		71.25	
14				Saturated, Very dark gray [10YR 3/1], ORGANIC SANDY SILT, OL, no to low plasticity, medium dense to very loose, woody debris and amorphous organics.						High blow count from wood debris.
15		3"SS	30				19			
16		3"SS	0				3			
17										
18		3"SS	0				2			
19			100	Saturated, Black [10YR 2/1], ORGANIC SILTY SAND, OL, low plasticity, woody debris and amorphous organics, high plasticity clay at base.	NP 65	NP 37			6.28 64.53	Shelby advance 1' until refusal. Pocket Penetrometer: 0.27 tsf @ 19.5'.
20		3"SS	50	Saturated, Dark gray [10YR 4/1], GRAVEL with Sand, GP, non-plastic, very dense, gravels subrounded to subangular to 2.5" maximum diameter, sands medium to coarse-grained.			100			
21										

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C06

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22–23						Saturated, Dark gray [10YR 4/1], GRAVEL with Sand, GP, non-plastic, very dense, gravels subrounded to subangular to 2.5" maximum diameter, sands medium to coarse-grained. *(Continued)*						Advanced casing to 24'.
		24–25				3"SS	70	Saturated, Dark gray [10YR 4/1] Pale brown [10YR 6/3], GRAVEL with Sand, GW, non-plastic, very dense, gravels as above but to 1" diameter, assorted minor gravels of varying color mixed with fines and grey argillite cuttings toward to bottom of this interval, most gravels well rounded.	NP	NP	64			
		26–28												Advance casing to 29'.
		29				3"SS	100	Light to dark grey argillite. Bedding dips @ 35 degrees. Primary fractures in this interval are abundant @ 60 degrees and vertical. Fractures with a 20-25 degree dip are very abundant. Fracture separation is variable from <1 mm, and occur up to 1". Moderately weathered throughout.			100			Start coring at 29'. No recovery 29-30.5'.
		30					0							
		31–32												30.5'-35.5': RQD = 15 Most of core is crushed between the three fracture trends.
		33					80							
		34–35												
		36						35.5-38.5': Fractures horizontal to near vertical, highly weathered zones of gray clay on some fractures ~ 1/8" wide.						35.5'-38.5': RQD = 0
		37					90							
		38												
		39						38.5-40.5': Fractures horizontal to 45 degrees spaced 0-3".						38.5'-40.5': RQD = 0
		40					95							
		41						40.5-42': Fractures horizontal to vertical spaced 0-2.5". Weathered to clay at 42.5'.						40.5'-42: RQD = 0
		42						42-44': Fractured into rubble..						42'-44': RQD = 0
		43					25							
		44					95							

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C06

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		45					95	44-45.5': Quartzite vein 1" thick at 70 degrees to horizontal.						44'-45.5': RQD = 0
		46												45.5'-49: RQD = 26
		47					95							
		48						1/4" wide quartz vein at 48.5' angled at 45 degrees.						
		49						Total Depth 49'.						
		50												
		51												
		52												
		53												
		54												
		55												
		56												
		57												
		58												
		59												
		60												
		61												
		62												
		63												
		64												
		65												
		66												
		67												

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ADDRESS: 205 Haggerty Lane, Suite 120
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Drill Hole No. GC-C07

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Chris Peterson
DATE STARTED / FINISHED: 7/15/05 - 7/16/05	DRILL TYPE: CME-850
LOGGED BY: Jeff Riedel and Dan McCaffery	HOLE DIAMETER: 5" Casing
GROUND SURFACE ELEVATION: 3239.3 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17043872.8, 918723.9	

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1				Shelby	0	No recovery, casing sank to 2.5'.						Driller noted soft sand.
▼		2												Ground water encountered while drilling.
		3				2" SS		Saturated, Brown [10YR 4/3], SAND, SP, non-plastic, loose, Fine to medium grained sand.			6			Driller lowered casing to 2.5' to prepare to drive splitspoon. Driller can only push 18" because of rod location.
		4						Saturated, Very dark gray [2.5Y 3/1], SAND, SP, non-plastic, black organic vertical parting covers 3/4 of bottom of shelby.						Organics with size ranging from 1-3cm in length and width and 1mm in thickness
		5				Shelby	71							
		6						Saturated, Brown [10YR 4/3], SAND, SP, non-plastic, medium dense, Fine to medium grained sand.						Organics present with size ranging from 1-3 cm in length and width and 1 mm in thickness
		7				2" SS	39				19			
		8				2" SS	56	Saturated, Brown [7.5YR 5/2], GRAVEL with Silt and Sand, GW-GM, angular to subrounded, non-plastic, very dense.			100			Shelby was pushed and was bent. Driller feels Shelby did not advance. Went to SS started at 7.5'.
		9						Saturated, Gray [10YR 6/1], GRAVEL with Silt, GW-GM, subangular to subrounded, very dense, small chunk of greenish clay within bag sample.						
		10				2" SS	38				90			
		11						Wet, Dark yellowish brown [10YR 4/4], SAND, SP, non-plastic, very dense, a few woody organics present.						Advanced 5'.
		12												
		13												
		14												
		15												@ 14.5-16' Driller noted could be on bedrock. Cuttings similar mineralogy to gravels recovered in SS @ 7.5-11'.
		16				2" SS	60	Wet, Light brownish gray [10YR 6/2], GRAVEL with Sand, GP, angular, non-plastic, very dense.			100			
		17												Material was plugged in nose of SS. May be reason for high blow counts.
		18												
		19												Advanced 5' past 16' to 21'. Driller noted tricone advanced gradually implying bedrock.
		20												
		21												

PIEDMONT ENGINEERING, Inc.
1215 Apple's Way Belgrade, Montana 59714

CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

PROJECT NAME: Milltown Dam

Drill Hole No. GC-C07

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22	X			2" SS		Core, 21'-22.5'; Argillite, foliated, dark maroon, phylitic texture, fracture surfaces contain secondary minerals, probably illite, very discontinuous, particle size from 1/16" to 3".			100			On 7/16/05 start coring 21'-22.5'; RQD = 0
		23						Core, 22.5'-25.5'; Argillite, very discontinuous. Discontinuities primarily parallel with foliation (horizontal). One vertical discontinuity observed between 24.5' and 25'. Fill of secondary minerals, probably illite (both horizontal & vertical).						Core 22.5'-25.5'; RQD = 0
		24												
		25						Core, 25.5'-27.5'; Argillite, very discontinuous, --- of core length appears granular, 1/2-3/4" angular particle size. Dark maroon to olive gray. Filled discontinuities observed in competent 2 1/2" piece, filled discontinuities ~7 per 2 1/2" (density), primarily parallel with foliation, 10 degrees from horizontal.						Core 25.5'-26.5'; RQD = 0
		26												Core 26.5-27.5'; RQD = 0; Driller notes most of discontinuities pre-existing in bedrock.
		27						Core, 27.5'-32.5'; Argillite, very discontinuous, dark maroon to dark gray. Filled discontinuities observed at 30.5' and 31', probably calcite. No dominant discontinuity orientation.						Core 27.5'-32.5'; RQD = 0
		28												
		29												
		30												
		31						Core, 32.5'-37.5'; Argillite, very to highly discontinuous, dark maroon to greenish gray, filled competent discontinuities at 34.5', 35.5', and 36', oriented ~ 15 degrees from horizontal.Primary discontinuities ~ 10-20 degrees from horizontal. Approx. 6" of run contains highly angular granular particles, some discontinuity contain secondary minerals, probably illite.						
		32												Core 32.5'-37.5'; RQD = 21
		33												
		34												
		35						Core, 37.5'-42.5'; Argillite, very to highly discontinuous, greenish gray to maroon color, competent discontinuities filled at 38-39'. Primary discontinuties orientation at 10-20 from horizontal. Fill discontinuity at 41.5' oriented at ~ 65 degrees from horizontal filled probably with calcite or quartz. Approximately 4" of run contains granular highly angular particles at 41'.						
		36												
		37						Core, 42.5'-47.5'; Argillite, very to highly discontinuous, greenish gray. Primary discontinuities oriented ~ 10-30 degrees from horizontal, highly discontinuous at 44.5' ~ 4" thick zone, particles ~ 1/8-1/4" in size, highly angular, some discontinuities filled with secondary minerals, probably illite.						Core 37.5'-42.5'; RQD = 28
		38												
		39												
		40												
		41												
		42												
		43												Core 42.5'-47.5'; RQD = 18
		44												

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C07

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		45–67		■				Core, 47.5'-52.5'; Argillite highly to very discontinuous. Greenish gray to maroon. Primary discontinuity orientation ~ 15-45 degrees from horizontal. Approx. 6" of run contains very discontinuous material which is highly angular, granular particles with size between fine to 1/2". Low percent of discontinuities contain secondary minerals, probably illite.						Core 47.5'-52.5'; RQD = 15
								Core, 52.5'-57.5'; Argillite, highly discontinuous. Greenish gray to dark maroon, primary discontinuities orientation approx. 20-40 degrees, very discontinuous at 52.5-53.0', very discontinuous material is highly angular granular particles with size ranging from fines to 1/4" diameter.						Core 52.5'-57.5'; RQD = 8
								Core, 57.5'-62.5'; Argillite, highly discontinuous, gray to dark maroon, primary discontinuities 20-40 degrees to horizontal. Very discontinuous from 60.5-60.75'. Very discontinuous material is highly angular, granular particles with size range 1/8"-3/4", surfaces of very discontinuous particles contain secondary minerals, probably illite. Other discontinuities also secondary minerals are also observed.						Core 57.5'-62.5'; RQD = 18
								Core, 62.5'-67.5'; Argillite, discontinuous to highly discontinuous, greenish. Primary discontinuities oriented ~ 5-45 degrees from horizontal. Discontinuities mainly observed to be parallel with depositional bedding. Discontinuities are observed to have secondary minerals on surface.						Core 62.5'-67.5'; RQD = 54

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C07

WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		68						Core, 67.5'-72.5'; Argillite, discontinuous to highly discontinuous, greenish to dark maroon. Primary discontinuities oriented from 15-30 degrees. Competent fracture filled with white mineral, probably quartz.						Core 67.5'-72.5'; RQD = 49
		69												
		70												
		71												
		72												
		73						Total Depth = 72.5'.						
		74												
		75												
		76												
		77												
		78												
		79												
		80												
		81												
		82												
		83												
		84												
		85												
		86												
		87												
		88												
		89												
		90												

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Drill Hole No. GC-C08

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 7/14/05 - 7/15/05	DRILLER: HAZ-Tech Chris Peterson
LOGGED BY: Jeff Riedel and Dan McCaffery	DRILL TYPE: CME-850
GROUND SURFACE ELEVATION: 3237.8 ft	HOLE DIAMETER: 5" Casing
BOREHOLE LOCATION: 17044203.8, 919428.2	HAMMER TYPE: 140# Automatic Trip Hammer

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DEPTH (FT)	SAMPLES: DRIVE / UNDISTURBED / BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
1	UNDISTURBED	Shelby	90	Saturated, Dark gray [2.5Y 4/1], SAND, SP, loose, medium grained with trace organics.						
2	DRIVE									Pocket penetrometer with adaptor @ 2' = 2.3 tsf
3	DRIVE	3" SS	25	Moist, Dark grayish brown [10Y 4/2], SAND with Clay, SP-SC, loose, medium to fine grained sand with small fibrous organics.			4			
4	UNDISTURBED	Shelby	100	Moist, Very dark gray [2.5Y 3/1], SAND, SP, loose, medium grained with trace organics, thin layer of clay with sand (med-high plasticity) at about 5.3'.						
5										
6	DRIVE	3" SS	0	Loose, no recovery.			8			Pocket penetrometer with adaptor @ 5.5' = 2.5 tsf
7	DRIVE									
8	DRIVE	2" SS	30	Moist, Very dark grayish brown [10YR 3/2], CLAYEY SAND, SC, low plasticity, medium dense.			16			
9	UNDISTURBED	Shelby	100	Saturated, Very dark gray [2.5Y 3/1], SAND, SP, medium dense, medium to fine grained with trace organics.						
10										
11	DRIVE	2" SS	50	Saturated, Dark gray [2.5Y 4/1], SAND with Clay, SP-SC, non-plastic, very dense, very fine to fine grained sand, small, planar organics present with one large piece of wood.			100			Start drilling on 7/15/05 at 10.5'. High blow counts from wood debris- material may have sloughed into hole.
12	DRIVE			Saturated, Dark gray [2.5Y 4/1], GRAVEL with Sand, GP, non-plastic, very dense, medium grained, wood debris present at top of interval, broken maroon rocks at bottom of interval.						
13	DRIVE	2" SS	11				85			Drives through wood and rock material sloughed into hole from above so not saved. Advanced 13.5-15.5'. Driller noted gravel while advancing.
14										
15										
16	DRIVE	2" SS	33	Saturated, Dark reddish brown [5YR 3/2], GRAVEL with Sand, GW, subangular to subrounded, non-plastic, very dense.			48			
17	DRIVE									Advanced 17.5-20.5'. Driller noted gravels while advancing.
18	BULK			Saturated, Dark reddish brown [5YR 3/2], SAND, SP, no to low plasticity, very dense.						
19	BULK									
20	BULK									
21	DRIVE	2" SS	50				56			

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C08

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		22	X			2" SS	50	Saturated, Grayish brown [10YR 5/2], GRAVEL, GP, subrounded, low plasticity, very dense. *(Continued)*			56			
		23						Saturated, Dark reddish gray [5YR 4/2] Reddish brown [5YR 4/3] to 23', SAND with Gravel, SP, very dense, fine grained sand to 23', then coarse grained sand.						Advanced 22.5-25.5'. Driller noted boulders up to 1' diameter while advancing.
		24												
		25												
		26	X			2" SS	33	Saturated, Pinkish gray [5YR 6/2], GRAVEL with Silt and Sand, GP-GM, angular to subrounded, no to low plasticity, dense to very dense.			36			
		27												Advanced 27.5-30.5'. Driller noted boulders while advancing.
		28												
		29												
		30												
		31	X			2" SS	0				100			Advance 30.75-32.75'. Driller noted boulders/cobbles. Probably not bedrock.
		32												
		33	X			2" SS	0				100			
								Total Depth = 33.6'.						
		34												
		35												
		36												
		37												
		38												
		39												
		40												
		41												
		42												
		43												
		44												

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Drill Hole No. GC-C09

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 7/16/05 - 7/17/05	DRILLER: HAZ-Tech Chris Peterson
LOGGED BY: Jeff Riedel	DRILL TYPE: CME-850
GROUND SURFACE ELEVATION: 3238.4 ft	HOLE DIAMETER: 5" Casing
BOREHOLE LOCATION: 17043832, 918671	HAMMER TYPE: 140# Automatic Trip Hammer

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1				Shelby	0	No recovery.						No evidence of material on pulled shelby tube.
		2						Saturated, Brown [7.5YR 4/3], SAND, SP, subangular, very loose, cutting from 0-5'. Medium to fine grain sand. Suspended solids in flushed water during reaming, organics plentiful.						Drillers lowered casing to obtain SS. Casing sank to depth below sediment surface of 5' so no SS was taken at this depth. Cuttings were collected during reaming out of casing. Water encountered at 2' while drilling.
		3												
		4												
		5				2" SS	100	Saturated, Very dark gray [10YR 3/1], SILT, ML, low to medium plasticity, soft.			0			
		6						Saturated, Dark gray [2.5Y 4/1], ELASTIC SILT, MH, high plasticity, very soft.						
		7				Shelby	100	Saturated, Dark gray [2.5Y 4/1], SAND, SP, non-plastic, loose, medium to fine grained.						
		8						Loose, no evidence of material in tube.						
		9				3" SS	0				6			
		10				2" SS	83	Saturated, Brown [10YR 4/3], SAND with Silt, SP-SM, medium dense, medium to fine grained sand with plentiful black organics.			24			
		11						Saturated, Dark gray [2.5Y 4/1], SAND with Silt, SP-SM, very dense.						Attempted Shelby at 11'. Failed. Shelby came out bent and empty.
		12				2" SS	53	Saturated, Dark grayish brown [10YR 4/2], GRAVEL with Sand, GW, non-plastic, very dense.			100			
		13				3" SS	56	Saturated, Dark grayish brown [10YR 4/2], GRAVEL with Sand, GW, subangular to rounded, non-plastic, very dense.			100			Drive count of 75/3". Sounds like hitting bedrock. Tricone from 14-15'. Attempting to core @ 15'.
		14						Greenish gray [5GY 6/1], Core, 15'-20'; Argillite, highly discontinuous. Primary discontinuities oriented about horizontal to 40 degrees.						
		15												
		16												Core 15'-20'; RQD = 34
		17				Core	95							
		18												
		19												
		20				Core	95							
		21												

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C09

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		22						Core, 20'-25'; Argillite, discontinuous primary orientation range from horizontal to 60 degrees to horizontal. Primary fracture contained observable secondary minerals, probably illite.						Core 20'-25'; RQD = 63
		23				Core	95							
		24												
		25						Core, 25'-30'; Description, 25'-28.5'; Argillite, greenish gray, primary discontinuities oriented at ~0-60 degrees from horizontal. Highly discontinuous zone from 27.5-28.5'. Particles highly angular with diameter ~3/8".						Core 25'-28.5'; RQD = 13
		26												
		27				Core	83							
		28						Description, 28.5'-30'; Argillite, highly discontinuous, primary discontinuity orientations ~5-30 degrees. Very discontinuous from 29.5'-30'. Particles angular with diameter = 3/8".						Core 28.5'-30'; RQD = 0
		29				Core								
		30						Core, 30'-35'; Argillite, very to highly discontinuous greenish gray to maroon. Discontinuity orientation highly variable. Observed yellowish secondary materials in primary discontinuities (probably illite).						Core 30'-35'; RQD = 7
		31												
		32												
		33				Core	100							
		34												
		35						Core, 35'-40'; Argillite, discontinuous, primary discontinuity orientation either ~0 or ~25 degrees from horizontal. Material is highly discontinuous from 35'-35.5'. Particles highly angular. At 37.5' core shows zone of gauge-like material. Core is greenish gray to maroon from 39'-40'.						Core 35'-40'; RQD = 39
		36												
		37												
		38				Core	100							
		39												
		40						Core, 40'-43.5'; Argillite, very to highly discontinuous. Greenish gray to maroon. Very discontinuous areas contain angular granular particles ~3/8" (coarse sand).						Core 40'-43.5'; RQD = 0
		41												
		42				Core	100	Core, 43.5'-45'; Argillite, greenish gray to maroon.						
		43												Core 43.5'-45';RQD = 0
		44				Core								

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PROJECT NAME: Milltown Dam

Drill Hole No. GC-C09

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		45				Core		Core, 45'-50'; Argillite, greenish gray to maroon. Primary discontinuity orientation variable. Observable secondary minerals are yellowish.						Core 45'-50'; RQD = 18
		46												
		47												
		48				Core	95							
		49												
		50						Core, 50'-55'; Argillite, greenish gray to maroon (very little). Primary discontinuity orientation variable. Observable secondary minerals in discontinuities. At 54.5', zone of angular granular particles with size from coarse sand to 3/8". At 50'-50.5', zone of angular granular material with size from 1/4"-3/4" diameter.						Core 50'-55'; RQD = 28
		51												
		52												
		53				Core	100							
		54												
		55						Core, 55'-60'; Argillite, greenish gray to maroon. Very discontinuous. 90% of recovered length consisted of angular granular particles with size range from coarse sand to 3/4". Small portion of recovered core contains low plastic fines. Origin of fines seems to be surrounding bedrock.						Core 55'-60'; RQD = 0
		56												
		57												
		58				Core	40							
		59												
		60						Core, 60'-65'; Argillite, very to highly discontinuous. Greenish gray to dark maroon. Discontinuity orientations range from 0-30. *(Continued)*						Core 60'-65'; RQD = 0
		61												
		62												
		63				Core	60							
		64												
		65						Total Depth 65'.						
		66												
		67												

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Drill Hole No. BF-C01

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Chris Peterson
DATE STARTED / FINISHED: 4/5/05 - 4/6/05	DRILL TYPE: CME-850
LOGGED BY: Ryan Norkoli	HOLE DIAMETER: 5" Casing
GROUND SURFACE ELEVATION: 3238.0 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17043628.7, 918252.8	

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		1				2.5" BL	100	Saturated, Very dark gray [10YR 3/1], SILT, ML, medium plasticity, very loose.			2			
						2.5" BL		Saturated, Dark gray [N4], SILT, ML, medium plasticity, very loose.						
						2.5" BL		Saturated, Very dark gray [10YR 3/1], SILT, ML, low to medium plasticity, observed sands @1.5', sands very fine grained, lower 2' is silt with sand w/ fine-grained sands.						Pocket penetrometer reading of .25 tsf @ 3.5'.
		2												
		3				Shelby	100							Driller reports soft when advancing tube @ 3'.
		4						Saturated, Very dark gray [10YR 3/1], SILTY SAND, SM, non-plastic, loose, observed on bottom, sands fine grained.						
		5				Shelby	80		NP	NP			30.95	Woody debris present at bottom of sampler; fell out of tube at surface.
		6				3"SS	70	Saturated, Very dark gray [10YR 3/1], SAND, SP, very dense, medium-grained, uniform.			100			
		7				2.5" BL		Saturated, Very dark gray [10YR 3/1], SILTY GRAVEL with Sand, GM, very dense, gravels to 1.5" maximum diameter, subrounded to subangular, sands fine to medium-grained.						Advanced from 7-8.5'.
		8												
		9				3"SS	60	Saturated, Dark gray [10YR 4/1] Very dark gray [10YR 3/1], GRAVEL with Sand, GP, dense to very dense, transition to secondary color in the lower half of interval, lower half has higher % of fractured gravels, sands medium to coarse-grained.			50			
		10												Advanced from 10-13.5'.
		11												
		12												
		13												
		14				3"SS	40				36			
		15												
		16												
		17						Greenish gray [5GY 6/1], very dense, weathered argillite bedrock.						Driller suspects bedrock @ 17'
		18												
		19				3"SS	90	Total depth 19'.			100			
		20												
		21												

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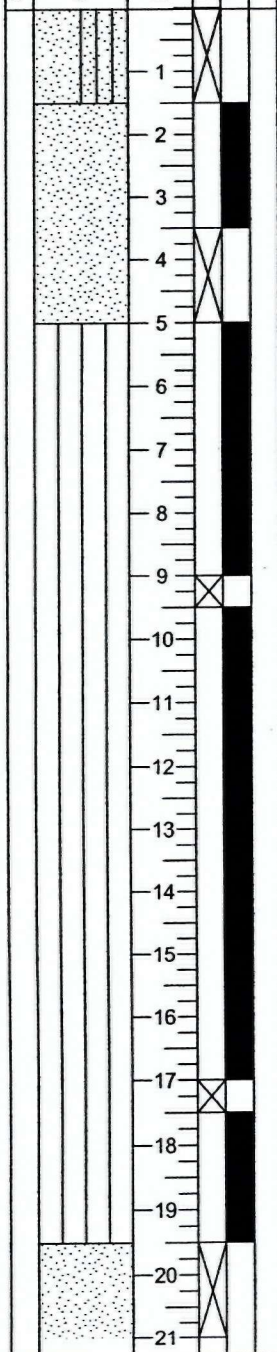
Drill Hole No. CD-C03

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 4/6/05 - 4/6/05	DRILLER: HAZ-Tech Chris Peterson
LOGGED BY: Ryan Norkoli	DRILL TYPE: CME-850
GROUND SURFACE ELEVATION: 3251.1 ft	HOLE DIAMETER: 5" Casing
BOREHOLE LOCATION: 17043569.4, 917368.6	HAMMER TYPE: 140# Automatic Trip Hammer



DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
						This log is part of a report prepared by Piedmont Engineering, Inc. for this project and should be read with the report. This summary applies only at the location of the boring and at the time of the drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
1	X			3" SS	40	Saturated, Dark gray [10YR 4/1], SAND with Silt, SP-SM, non-plastic, loose.			3			
2		■		Shelby	20	Saturated, Dark gray [10YR 4/1], SAND, SP, non-plastic, very loose, sands fine to medium-grained, woody debris and organics present.						Poor recovery.
3		■										
4	X			3" SS	0				0			
5		■				Saturated, Very dark gray [10YR 3/1] Dark gray [10YR 4/1], SILT, ML, medium plasticity, plasticity is none to med in the upper 4', with a zone of high plasticity from 12-16', otherwise medium plasticity throughout interval, sands very fine, trace fine grained sands and fine fibrous organics in sample, very soft throughout.				75.8	45.29	
6		■		Shelby	95		NP	NP		74.2	48.18	CU Triaxial
7		■								78.3	39.2	Pocket penetrometer: 0.16 tsf at 7'.
8		■		Shelby	80							
9	X			3" SS	75				0			Pocket penetrometer: 0.08 tsf at 9'.
10		■		2.5" BL								
				2.5" BL								
11		■		2.5" BL	100							
12		■								67.1	62.41	
13		■		Shelby	80		64 56	42 36		65.2 76.7	55.56 52.88	CU Triaxial
14		■										Pocket penetrometer: 0.11 tsf at 14'.
15		■		Shelby	95							
16		■		2.5" BL	100							Pocket penetrometer: 0.22 tsf at 16'.
				2.5" BL	100							
17	X			3" SS	100				2			No recovery.
18		■		Shelby	0							
19		■										
20	X			3" SS	40	Dark gray [10YR 4/1], SAND, SP, non-plastic, loose, trace fine sands and fine fibrous organics, fine to medium-grained.			7			
21												

PIEDMONT ENGINEERING, Inc.
1215 Apple's Way Belgrade, Montana 59714

CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

PROJECT NAME: Milltown Dam

Drill Hole No. CD-C03

This log is part of a report prepared by Piedmont Engineering, Inc. for this project and should be read with the report. This summary applies only at the location of the boring and at the time of the drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22	X			3" SS	0	Dark gray [10YR 4/1], SAND, SP, non-plastic, loose, trace fine sands and fine fibrous organics, fine to medium-grained. *(Continued)*			3			
		23	X			2" SS	20				4			
		24	X					Saturated, Dark gray [10YR 4/1], SILTY SAND, SM, non-plastic, loose, fine to medium-grained.						Organics clogged in bit.
		25	X			2" SS	20				5			
		26	X					Saturated, Black [10YR 2/1], ORGANIC SILTY SAND, SM, contains 1/4" fragments of wood debris and makes up 50-60% of sample, also contains amorphous organics.						
		27	X			2" SS	20	Saturated, Very dark gray [10YR 3/1] Dark gray [10YR 4/1], SILTY GRAVEL with Sand, GM, non-plastic, gravels are fractured by spoon, to a maximum of 1" diameter and are subrounded, gravels are multi-colored, secondary color shade is dominant in the lower half of this interval with fractured gravels to 3" maximum diameter, 31-36' is dense to very dense.			41			
		28	X											
		29	X											
		30	X											
		31	X											
		32				3" SS	50				57			
		33												
		34												
		35												
		36												
		37	X			3" SS	80	Saturated, Very dark gray [10YR 3/1], GRAVEL with Sand, GP, non-plastic, very dense, mixed cream, light grey quarzite, dark grey and maroon argillite, and dark olive green siltite gravels, gravels are part of coarse alluvium, similar to gravels above with fragments of rock in the cobble size range.			100			Tried core drilling at 37.5' no recovery. Switched back to split spoons for sample at 40'.
		38												
		39												
		40	X					GRAVEL, GP, non-plastic, very dense, similar to gravels above with fragments of rock in the cobble size range, gravels are part of coarse alluvium.						
		41	X			3" SS	100				62			
		42						Medium to dark grey argillite with very fine laminae. Weathered fracture surfaces have minor iron oxide stain, some light green stain, as well as calcite fracture fill. At least one fracture surface contains a clay cement.						The contact between bedrock and overlying sediment is based on field observations
		43												
		44												

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PHONE NUMBER: 406-522-0251

PROJECT NAME: Milltown Dam

Drill Hole No. CD-C03

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		45				3" SS	100	Medium to dark grey argillite with very fine laminae. Weathered fracture surfaces have minor iron oxide stain, some light green stain, as well as calcite fracture fill. At least one fracture surface contains a clay cement. *(Continued)*			100			3" split spoon went 1.5" in 75 blows @ 44'. Started coring at 44'. No recovery.
		46				Core	0							
		47						Most of this cored interval is crushed argillite. Laminae dip @ 35 degrees. Primary fracture directions are not discernible due to crushed nature of sample.						46'-49.5': RQD = 0
		48				Core	80							
		49						Total Depth 49.5'.						
		50												
		51												
		52												
		53												
		54												
		55												
		56												
		57												
		58												
		59												
		60												
		61												
		62												
		63												
		64												
		65												
		66												
		67												

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CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

Drill Hole No. CD-C04

PROJECT NAME: Milltown Dam	DRILLER: HAZ-Tech Chris Peterson
DATE STARTED / FINISHED: 4/1/05 - 4/1/05	DRILL TYPE: CME-850
LOGGED BY: Ryan Norkoli	HOLE DIAMETER: 5" Casing
GROUND SURFACE ELEVATION: 3243.0 ft	HAMMER TYPE: 140# Automatic Trip Hammer
BOREHOLE LOCATION: 17043754.2, 917275.4	

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1		■		2.5" BL	80	Saturated, Very dark brown [10YR 2/2], SAND, SP, non-plastic, very loose, sands medium-grained.	NP	NP	14		29.49	
		2	X			3" SS	0				3			No recovery. No catcher on spoon so sands fell out.
		3	X			3" SS	0				3			3': driller adding water to rods and water being lost to sediment as fast as added.
		4	X											
		5	X			3" SS	10	Saturated, Very dark gray [10YR 3/1] Dark yellowish brown [10YR 3/4], SILTY GRAVEL with Sand, GM, no to low plasticity, dense, gravels subrounded to subangular to 1" maximum diameter, sands medium-grained to coarse, included coarse organic sands from sands above, color transition from primary color to additional color.			36			
		6	X											
		7	X			3" SS	10	Saturated, Very dark gray [10YR 3/1] Very dusky red [10R 2.5/2], GRAVEL with Sand, GP, subangular to subrounded, non-plastic, medium dense, most gravels 1/4" or smaller with a few to 1" max, there are a number of colors in the gravels, those listed are primary.			26			
		8	X			3" SS	30				14			
		9	X											
		10	X			3" SS	5				21			
		11	X			2" SS	60	Saturated, Very dark grayish brown [10YR 3/2] Very dark gray [10YR 3/1], SILTY GRAVEL with Sand, GM, no to low plasticity, dense, contains a lense of dark grey organic GM, most sample grey subangular to subrounded gravels to a 1" max diameter, sands medium to coarse-grained.			50			Switched to 2" split spoon to attempt to get better recovery.
		12	X											
		13	X			2" SS	50	Saturated, Very dark gray [10YR 3/1] Very dusky red [10R 2.5/2], GRAVEL with Sand, GP, subangular to subrounded, non-plastic, very dense, intact gravels to 1" max diameter, gravel fragments indicate there may be larger gravels in strata, sands medium to coarse-grained.			100			
		14						Interbedded maroon and dark grey argillite, upper ~1' is fractured, very weak reaction to HCl.						Tricone used from 14' to confirm that bedrock was encountered. Driller said it felt like fractured bedrock until 17 feet. At 17' BSS encountered very hard bedrock.
		15												
		16												
		17						Total Depth 17'.						
		18												
		19												
		20												
		21												

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ADDRESS: 205 Haggerty Lane, Suite 120
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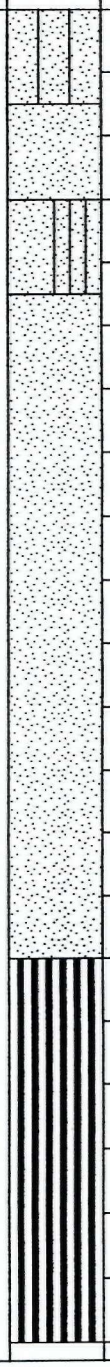
PHONE NUMBER: 406-522-0251

Drill Hole No. EB-C01

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 4/1/05 - 4/2/05	DRILLER: HAZ-Tech Chris Peterson
LOGGED BY: Ryan Norkoli	DRILL TYPE: CME-850
GROUND SURFACE ELEVATION: 3248.9 ft	HOLE DIAMETER: 5" Casing
BOREHOLE LOCATION: 17043579.7, 917229.4	HAMMER TYPE: 140# Automatic Trip Hammer



DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
1				3" SS	0	Saturated, Dark gray, SILTY SAND, SM, very loose, with a trace of organic material based on tip of split spoon.			2			
2				3" SS	10	Saturated, Very dark brown [10YR 2/2], SAND, SP, non-plastic, loose, sands fine to medium-grained.			6			
3				3" SS	35	Saturated, Very dark gray [10YR 3/1] Dark brown [10YR 3/3], SAND with Silt, SP-SM, non-plastic, medium dense, contains a lense of dark grey SP-SM w/organics, sands fine to medium-grained.			12			
4												
5				2.5" BL	100	Saturated, Very dark gray [10YR 3/1], SAND, SP, non-plastic, loose to medium dense, sands fine to medium-grained.			30			
6				3" SS 2.5" BL	70 100							
7				3" SS	0				4			
8				2" SS	25				4			
9												
10				2" SS	30				4			
11												
12				2" SS	40				7			
13												
14				2" SS	100		NP	NP	5		25.95	
15						Saturated, Dark gray [2.5Y 4/1], ELASTIC SILT, GW-GM, medium to high plasticity, soft to very soft throughout most of interval.						Pocket penetrometer: 0.11 tsf @ 17.5'.
16					100							
17							65	39			75.28	Started drilling at 17.5' on 4/2/05 at a nearby location. Northing: 17043574.81 Easting: 917221.14 with elevation: 3249.4
18												
19												
20					70							
21												

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CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

PROJECT NAME: Milltown Dam

Drill Hole No. EB-C01

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22	X			2" SS	5	Saturated, Very dark grayish brown [10YR 3/2], SILTY GRAVEL with Sand, GM, non-plastic, medium dense, gravels subrounded to 1" maximum diameter, trace organics.			11			
		23	X											
		24	X			2" SS	1	Saturated, Dark gray [10YR 4/1] Brown [10YR 4/3], SAND with Gravel, SP, non-plastic, loose to medium dense, sands fine to medium-grained, gravels round to subround to 1" maximum diameter, sands medium to coarse-grained in lower 2'.			7			Driller reports gravels while drilling.
		25	X											
		26	X			2" SS	5				11			
		27	X					Saturated, Dark gray [10YR 4/1] Dark olive brown [2.5Y 3/3], GRAVEL with Sand, GP, non-plastic, loose, gravels to 2.5" maximum diameter in sampler, subrounded and subangular fragments present, grades to gravel in lower 2'.						Switched to 3" spoons to get better recovery.
		28	X			3" SS	10				9			Advanced casing from 28.5' to 31.5'. Small sample. Rock plugged split spoon.
		29												
		30												
		31												
		32	X			3" SS	15				9			
		33	X											Advanced casing from 33' to 36' where bedrock was encountered based on drilling.
		34												
		35												
		36						Driller stated bedrock encountered @ 36'. Total Depth 36'.						
		37												
		38												
		39												
		40												
		41												
		42												
		43												
		44												

PIEDMONT ENGINEERING, Inc.
1215 Apple's Way Belgrade, Montana 59714

CLIENT: Emc2
ADDRESS: 205 Haggerty Lane, Suite 120
Bozeman, Montana 59715
PHONE NUMBER: 406-522-0251

Drill Hole No. SW-C01

PROJECT NAME: Milltown Dam	
DATE STARTED / FINISHED: 4/2/05 - 4/2/05	DRILLER: HAZ-Tech Chris Peterson
LOGGED BY: Ryan Norkoli	DRILL TYPE: CME-850
GROUND SURFACE ELEVATION: 3247.0 ft	HOLE DIAMETER: 5" Casing
BOREHOLE LOCATION: 17043672.0, 917255.7	HAMMER TYPE: 140# Automatic Trip Hammer

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		1	X			3"SS	40	Saturated, Black [10YR 2/1], ORGANIC SILT, OL, no to low plasticity, loose, woody debris, fine fibrous organics, and amorphous organics.			2			
		2	X			3"SS	40	Saturated, Dark gray [10YR 4/1], SAND, SP, non-plastic, loose, fine to medium-grained.			8			
		3				2.5" BL		Saturated, Very dark gray [10YR 3/1], SILTY SAND, SM, non-plastic, sands very-fine to fine-grained, uniform, contains some lenses of Sand, SP, from 4.5-6' and some wood debris and amorphous organics 6-7.5', very loose 7.5-11', but otherwise loose.	NP	NP			34.02	
		4	X			3"SS	0				4			
		5	X			3"SS	10				9			
		6	X			3"SS	20				5			
		7	X											
		8	X			2"SS	1				0			Drill cuttings showing organic sands. Switched to 2" sampler to attempt to get better recovery @7.5'.
		9	X											
		10	X			3"SS	0				0			
		11						Saturated, Very dark gray [10YR 3/1] Black [10YR 2/1], ELASTIC SILT, MH, high plasticity, soft to very soft, trace of wood debris at 15', bottom of 13-15' Shelby sample is sandy organic silt.				64.8	54.28	
		12				Shelby	95					55.1	79.84	CU Triaxial
									59	35		53.0	87.82	
									62	35		55.7	62.84	
		13												Pocket penetrometer 0.19 tsf @ 13'.
		14				Shelby	95							
		15	X					Saturated, Dark gray [10YR 4/1] Very dark gray [10YR 3/1], GRAVEL with Sand, GW, non-plastic, medium dense to very dense, gravels subrounded to subangular to 1.5" maximum diameter, sand medium to coarse-grained.						Driller said it feels like gravel is encountered @15'.
		16	X			3"SS	0				16			
		17	X			3"SS	40				16			
		18	X											Advancing casing 5' to collect another sample.
		19												
		20												
		21												

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ADDRESS: 205 Haggerty Lane, Suite 120	
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PHONE NUMBER: 406-522-0251	

PROJECT NAME: Milltown Dam

Drill Hole No. SW-C01

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WELL LOG	GRAPHIC LOG	DEPTH (FT)	SAMPLES: DRIVE	SAMPLES: UNDISTURBED	SAMPLES: BULK	SAMPLE ID	RECOVERY (%)	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	CORRECTED SPT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS / TESTING
		22						Saturated, Dark gray [10YR 4/1] Very dark gray [10YR 3/1], GRAVEL with Sand, GW, non-plastic, medium dense to very dense, gravels subrounded to subangular to 1.5" maximum diameter, sand medium to coarse-grained. *(Continued)*						
		23												
		24	X			3"SS	70		NP	NP	56		3.35	
		25												Advanced casing.
		26												
		27												
		28	X			3"SS	25	Saturated, Dark gray [10YR 4/1], GRAVEL with Sand, GP, medium dense to very dense, gravels multi-colored, round to subrounded, fractured gravels intact to 1.5" maximum diameter and fractured to 2.5" maximum diameter.			20			
		29												Advanced casing.
		30												
		31												
		32												
		33				3"SS		Total Depth 33'.			100			No movement with sampler @ 33'. 33' was interpreted as bedrock based on lack of split spoon movement.
		34												
		35												
		36												
		37												
		38												
		39												
		40												
		41												
		42												
		43												
		44												

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ADDRESS: 205 Haggerty Lane, Suite 120
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PHONE NUMBER: 406-522-0251

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	EB-1 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986993.2 N, 871911.0 E)

ELEVATION : 3267.6 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/24/2006 END : 3/24/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
					Gravelly SILT (ML) at surface, grass and weeds.	SPT with CME Autohammer (140#, 30-inch drop).
5	5.0					Driller notes gravel at 3 ft.
	6.4	0.6	1-SS	14-18-50/4.5"-(R) (68/10.5")	POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), brown with multicolored gravel, moist, very dense, approximately 15% fines, 25% sand. [FILL]	Location of borehole is approximately 8 ft southwest of fenceline.
10	10.0					
	11.4	0.7	2-SS	1-33-50/5"-(R) (83/11")	Continued POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), similar to SS-1, maximum particle size is approximately 2 inches.	
15	15.0					Driller notes larger gravel/cobbles below ~14 ft, slow drilling.
	16.3	0.5	3-SS	15-34-50/3"-(R) (84/9")	Continued POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), similar to SS-2, approximately 5 to 10% fines [FILL], gravel is subangular to well-rounded, approximately 20 to 30% sand.	
20	20.0					
	21.5	0.6	4-SS	7-22-50 (72)	Continued POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), similar to SS-3, except wet.	
25	25.0					
	26.5	1.1	5-SS	15-34-43 (77)	Continued POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), zones with 5 to 10% fines, otherwise mostly coarse-grained (GP).	
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	EB-1 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986993.2 N, 871911.0 E)

ELEVATION : 3267.6 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/24/2006 END : 3/24/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	30.0					
	31.5	0.8	6-SS	8-24-28 (52)	POORLY-GRADED GRAVEL with SAND (GP), brown with red/green/tan/gray gravel, moist to wet, very dense, approximately 20 to 30% sand, gravel subangular, well-rounded.	SS-6 still appears to be FILL.
35	35.0					
	36.5	0.9	7-SS	11-8-11 (19)	Continued POORLY-GRADED GRAVEL with SAND (GP), multicolored gravel, wet, medium dense, gravel is fine and subrounded to well-rounded.	Entire outside of spoon is wet upon retrieval. SPT for SS-7 potentially collected in slough. SS-7 appears to be ALLUVIUM.
40	40.0					
	41.5	1.0	8-SS	16-18-18 (36)	Continued POORLY-GRADED GRAVEL with SAND (GP), wet, except dense, gravel, mostly fine with some coarse sized approximately 30 to 40% sand.	
45	45.0					
	46.5	0.5	9-SS	34-33-16 (49)	Continued POORLY-GRADED GRAVEL with SAND (GP), similar to SS-8.	Augers dropped - resulted in more slough in spoon (0.5 instead of typical 0.2).
50	50.0					
	51.5	0.2	10-SS	2-13-27 (40)	Continued POORLY-GRADED GRAVEL with SAND (GP), similar to SS-9.	SS-10 is primarily slough, only ~0.2 ft of gravel in shoe - no sample retained. Driller notes bigger cobbles and gravel at 52 ft.
55	55.0					
	55.5	0.5	11-SS	50/5"-(R) (50/5")	Residual/weathered rock as GRAVELLY CLAY (CL), green-gray, wet, very dense, hard.	SS-11 likely weathered surface of rock.
60						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	EB-2 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986643.9 N, 872134.2 E)

ELEVATION : 3261.2 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/27/2006 END : 3/27/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	0.6					
		1.7	1-ST	NA	Material at tip is SILT with SAND (ML), brown, wet, soft.	Cattails, reeds, hedges at surface, ground is frozen upper ~6 inches. Using piston sampler for shelbys.
	2.3					
	2.5					
		2.0	2-ST	NA	Material at tip is SILTY SAND (SM), brown, wet, very loose.	ST-2: TV = 0.1 kg/cm^2 PP = 0.5, 0.5, 0.25 tsf
	4.5					
5	5.0					
		1.8	3-ST	NA	Tip of ST-3 is LEAN CLAY (CL), brown-gray, wet, soft to firm, low plasticity.	ST-3: TV = 0.25 kg/cm^2 PP = 0.75, 0.75, 0.75 tsf
	7.0					
	8.0					
		2.0	4-ST	NA	Tip of ST-4 is POORLY-GRADED SAND (SP), brown-gray, wet, loose.	ST-4: PP = 0.5, 0.75 tsf
10	10.0					
		1.3	5-SS	2-1-0 (1)	SS-5: SILTY SAND (SM), brown, wet, very loose, slow to rapid dilatency, fine-grained. Tip of SS-5 is wood-bark (ponderosa).	
	11.5					
	12.0					
		1.0	6-ST	NA	Tip of ST-6 is SILTY SAND (SM), similar to SS-5, with organics, wood pieces.	ST-6: PP = 0.5, 0.5 tsf
	14.0					
15	15.0					
		0.8	7-ST	NA	Tip of ST-7 is LEAN CLAY (CL), gray, wet, soft, low plasticity.	ST-7: TV = 0.2 kg/cm^2 PP = 0.5, 0.5, 0.5 tsf
	17.0					
	18.0					
			8-ST	NA		ST-8: PP = 0.75, 0.75 tsf
20	20.0					
		1.3	9-ST	NA	Tip is SILTY SAND (SM), brown-gray, wet, very loose, rapid dilatency, sand fine to very fine grained.	ST-9: PP = 1.5, 1.25, 1.5 tsf
	22.0					
	23.5	1.2	10-SS	3-2-1 (3)		
	24.1					
	24.5		11-ST	NA		
25		0.4	12-SS	17-28-18 (46)	SILTY GRAVEL (GM), gray/purple/green, wet, dense, gravel fine to coarse grained, well-rounded.	Encounter gravel at 24.5 ft. (ALLUVIUM)
	26.0					
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	EB-2	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986643.9 N, 872134.2 E)

ELEVATION : 3261.2 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/27/2006 END : 3/27/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30.0						
	0.8	13-SS		13-38-42 (80)	Continued SILTY GRAVEL (GM), gray with purple and yellow coloring, very moist, very dense, 1.5-inch minus broken gravels, mixed argillites, silty and sandy matrix.	
31.5						
34.0						
34.2	0.1	14-SS		3-8-50-58//9" (58)	Begin Rock Coring at 34.2 ft below ground surface See the next sheet for the rock core log	Start coring at 34.2 ft. Continued on rock core log.
35						
40						
45						
50						
55						
60						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	EB-2 SHEET 3 OF 3

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986643.9 N, 872134.2 E)

ELEVATION : 3261.240 — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/27/2006 — END : 3/27/2006 — LOGGER : J. Butler, P.E.

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	GRAPHIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	34.2						
35	Core Run #15-HQ Length 4.8 ft Recovery 104%	0		Moderately to highly fractured into angular fragments, primary fractures dip 5 to 20% with occasional vertical fractures, stepped and rough, seem to be associated with bedding planes, surfaces are slightly weathered to more weathered and clayey in shale like zones, core came out relatively intact but broke into rubbly angular material while handling.		ARGILLITE BEDROCK, purple with green beds, fine-grained, thinly-bedded and laminated, slightly to moderately weathered, H=R3 with weak zones of R2 to R1, moderately to highly fractured, shale like zones of very thin bedded and platy or flaky partings, bedding dips 10 to 20 degrees.	Continued from soil boring log.
	39.0						
40	Core Run #16-HQ Length 3 ft Recovery 100%	0		Clayey bed at 41 ft.			
	42.0						Blocked at 42.0 ft. T.D. = 42.0 ft.
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	PB-1 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : NW Pedestrian Bridge Abutment (987131.8 N, 873464.5 E)

ELEVATION : 3262.9 ft — DRILLING CONTRACTOR : Haz Tech Drilling (Chris Peterson)

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : 20.5 ft bgs (3/23/2006) — START : 3/23/2006 — END : 3/23/2006 — LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5	5.0					
	6.5	1.5	1-SS	1-2-1 (3)	SILTY SAND (SM) grading to POORLY-GRADED SAND with SILT (SP-SM), red-brown, moist, very loose, sand fine to medium grained, approximately 15 to 20% fines.	SPT conducted with CME Autohammer, 140# 1.5-inch standard split-spoon samples.
10	10.0					
	11.5	1.1	2-SS	20-17-15 (32)	POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), brown with red and green gravels, moist, dense, gravel well-rounded, fine to coarse, sand fine to coarse, approximately 15% fines, ~40% sand.	
15	15.0					
	16.5	0.9	3-SS	43-25-44 (69)	SS-3 continued POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), slightly less fines (10%), very dense, gravel coarse.	Some larger gravel pieces wedged in sampler.
20	20.0					
	21.5	0.9	4-SS	14-20-20 (40)	POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), brown-red with green, white, and tan gravels, wet, dense, approximately 5 to 10% fines, ~30% sand.	
25	25.0					
	26.5		5-SS	15-20-25 (45)	Continued POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), similar to SS-4.	
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	PB-1 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : NW Pedestrian Bridge Abutment (987131.8 N, 873464.5 E)

ELEVATION : 3262.9 ft — DRILLING CONTRACTOR : Haz Tech Drilling (Chris Peterson)

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : 20.5 ft bgs (3/23/2006) — START : 3/23/2006 — END : 3/23/2006 — LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30.0						Let borehole sit for 30 minutes to measure water level.
31.5	0.5	6-SS		10-20-23 (43)	POORLY-GRADED GRAVEL with SAND (GP), brown-red to gray, wet, ≤5% fines.	Spoon had ~1 ft of sandy slough in top.
35						
40						
45						
50						
55						
60						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	PB-2 SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986817.8 N, 873561.2 E)

ELEVATION : 3259.0 ft — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged) — START : 4/26/2006 — END : 4/26/2006 — LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
						Driller notes light sands and gravels ~1-2 feet, otherwise soft.
						SPT w/cathead and rope safety hammer (140# 130")
	3.5					
	5.0	0.2	1-SS	1-0-1 (1)	LEAN CLAY (CL), dark brown-gray, wet, very soft, low to medium plasticity, a single 1.5-inch well-rounded gravel in spoon.	SS-1 possibly pushed a gravel through sample zone.
5						Slipbox to mudline = 8.5 ft.
	6.0					Slipbox to pool = 4.2 ft.
						Pool to mudline = 4.3 ft.
		0.0	2-ST	NA		ST-2, tip of tube is slightly damaged, although tube pushed easily.
	8.5					
			3-SS	1-0-0 (0)	LEAN CLAY (CL), brown-gray, wet. very soft, low plasticity, peppered with wood chips and some rootlets.	SS-3, PP = 0.25, 0.25, 0.25 kg/cm^2
10	10.0					
	~~10.3~~					
	~~10.7~~		4-VS	NA		VS-4: pushed by hand (very soft)
	~~11.0~~					Used med. vane, good test - took 8 rev. for full residual agreement.
		2.2	5-ST	NA	Tip of ST-5 is SILTY SAND (SM), brown, wet, very loose, approximately 30 to 40% fines.	ST-5 easy push
	13.5					TV = 0.15 kg/cm^2
						PP = 0.25, 0.25 kg/cm^2
		1.1	6-SS	1-1-1 (2)	SS-6 is interbedded LEAN CLAY (CL) and SILTY/CLAYEY SAND (SM/SC), brown, wet, soft/very loose.	
15	15.0					
	16.0					
		1.2	7-ST	NA	Tip of ST-7 is SILTY SAND (SM), gray, wet, loose, with ~20 to 30% fines.	Driller notes some gravel at ~17 to 18 ft mixed in matrix.
	~~18.2~~					
	~~18.5~~					
		1.1	8-SS	2-1-6 (7)	SS-8 SILTY SAND (SM) to SANDY SILT (ML), gray-brown, wet, loose to firm, ~30 to 70% fines, <5% small gravel in upper sample.	Driller notes larger gravel at 19.5 ft.
20	20.0					Cobbles and gravels (bony drilling) below 20 ft. Switch over to HQ rock coring at 22.5 ft.
					Small cobbles and coarse gravel recovered, max size is approximately 4 inches, sand with ~10% fines recovered on some gravels in run.	
25	25.5					
	27.0	0.8	9-SS	22-46-29 (75)	SS-9: POORLY-GRADED GRAVEL with SILT and SAND and COBBLES (GP-GM), pink-gray, wet, very dense, approximately 20% sand, 10% fines, 20% cobbles.	
						Backfilled borehole with bentonite chips.
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW1-1	SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : South Side I-90 (986546.6 N, 872209.3 E)

ELEVATION : 3261.5 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/30/2006 END : 3/30/2006 LOGGER : G. Warren

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	0.5					
	2.5	1.0	1-ST			
	3.0					
	5.0	1.7	2-ST		TIP: SAND (SP, brown, moist, loose, fine grained, 5% silt.	PP= 0.5; 0.5 tsf.
5	7.0	2.0	3-ST		TIP: SAND (SP), dark brown, moist, loose, fine to very fine grained, trace woody organics.	No PP - Sandy
	8.0					
	10.0	1.6	4-ST		TIP: SILT WITH FINE SAND (ML), dark brown, moist, soft, non-plastic, 10-20% very fine sand.	TV= 0.14 tsf.
10	12.0		5-ST		TIP: SAND (SP), with SILTY zones, brown, wet, loose, fine to medium grained, few wood fragments.	No TV or PP; loose sand.
	13.5					
	15.0	0.4	6-SS	0-1-1 (2)	SAND (SP), brown, moist, very loose, fine grained, no fines, abundant wood fragments, 1/2" thick gray SILTY/CLAY seam, very soft, very low plasticity.	Sandy, collect SPT.
15	17.0	0.5	7-ST			
	17.5					
	19.0	1.3	8-SS	WOR	LEAN CLAY (CL), gray to dark gray, moist, very soft, very low plasticity, fine sand, sandy clay seams.	Sample slid out of S.T., collected in baggie Sandy at 17.5' collect SPT.
20	21.0	2.0	9-ST		TOP: SILT/SAND MIX (SM-ML), dark brown, wet, soft. TIP: ORGANIC SILT (ML), black, slightly moist, soft.	PP= <1.0, <1.0 TV= 0.2
	22.5					
	24.5	1.8	10-ST			
25	25.0					
	26.5	1.1	11-SS	2-2-20 (22)	TIP: SOLID WOOD PIECE SAND (SP), brown, moist, loose, rapid dilatancy, fine grained. Piece of purple gravel in shoe. Alluvium at 26.5'	No TV - wood in ST driller noted "hit something".
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW1-1	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : South Side I-90 (986546.6 N, 872209.3 E)

ELEVATION : 3261.5 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/30/2006 END : 3/30/2006 LOGGER : G. Warren

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30.0						
	30.0 – 31.5	0.8	12-SS	14-28-25 (53)	SILTY GRAVEL (GM), dark gray, wet, very dense, 1.3" minus. TIP: May be Bedrock broken into thin angular slabs.	
31.5						
						Faster drilling @ 33 ft.
35						
35.0					SAND, mixed lithology possibly heaved.	
	35.0 – 36.5	1.5	13-SS	2-4-8 (12)	Sands and fine gravels.	
36.5						
						Continue smoother drilling.
40						
40.0						
	40.0 – 41.5	1.5	14-SS	3-9-50/5" (59/11")	TIP: SAND (SP), purple mardon, green, wet, loose, mixed lithology, 41.0' Argillite Bedrock	Refusal on bedrock, begin rock core.
41.5						
					Begin Rock Coring at 41.5 ft below ground surface See the next sheet for the rock core log	
45						
50						
55						
60						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW1-1	SHEET 3 OF 3

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : South Side I-90 (986527.0 N, 872244.1 E)

ELEVATION : 3261.5 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/30/2006 — END : 3/30/2006 — LOGGER : G. Warren

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	GRAPHIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
35							
40							
41.5							
	Core Run #15-HQ Length 3.5 ft Recovery 91%	10%		Fractures dip approximately 20 degrees from horizontal, slightly rough, planar to slightly wavy, clean to clay coated, thin "flakey" zones on joints. 3 to 5 fractures per foot. Clayey at 44'		Argillite Bedrock, purple, fine-grained, finely laminated, slightly weathered, H=R3, very poor rock mass, weathered zones on bedding plane, breaks (shale-like partings), bedding dips 15-20 degrees.	Begin HQ Core.
45							
45.0							
	Core Run #16-HQ Length 5 ft Recovery 98%	0%		Fractures dip approximately 10 to 20 degrees, slightly rough to rough, slightly wavy, weathered surfaces with flakey particles (shale-like), some staining. Highly fractured below 48.5', clayey rubble/gouge.		Argillite, similar to above, slightly to moderate weathered, H=R3, thin bedded. Shaley zone. More weathered/fractured below 48.5', clayey rubble.	
50							ROCK CORE TERMINATED AT 50.0'.
50.0							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW1-2 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : South Side I-90 (986616.8 N, 872513.1 E)

ELEVATION : 3255.5 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : Burley 4500C - Barge, HWT Casing Adv. (HQ Rock Core)

WATER LEVELS : — START : 4/19/2006 END : 4/20/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5	5.0					
	6.5	0.3	1-SS	11-14-15 (29)	POORLY GRADED GRAVEL WITH SAND (GP), multi-colored, wet, medium dense, gravel fine to coarse, rounded and subangular.	SPT cat/head & rope safety hammer, 2 wraps around cathead, (140 lb/30"), Mudline is 7.8 fet below pool. Pool elevation = 3259.8 ft.
	7.5					
	9.0	1.5	2-DMS	5-3-4 (7)	DMS-2 POORLY GRADED SAND (SP), gray, wet, loose, homogenous.	DMS-2 using 3-inch split spoon (D&M sampler) with rings. Driller notes smooth easy advancement.
10	10.0					
	11.5	1.1	3-DMS	2-3-3 (6)	DMS-3	DMS-3 3-inch split barrel samples, with rings.
	13.8					
	14.2		4-VS		VS-4 material stuck in vanes **LEAN CLAY (CL)**, gray, wet, firm, low to medium plasticity.	VS-4 collected material in vanes in ziploc VS-4 used small vane (12.5x2.3cm)
15	15.3					
	15.8		5-VS			VS-5 used medium vane (14.5x3cm) maxed out.
	17.4	2.1	6-ST		ST-6 POORLY GRADED SAND WITH SILT (SP-SM), brown, gray, wet, loose to medium dense, approximately ~5% fines.	Come back down to 15.0 ft. w/HWT casing and advanced shelby over zone disturbed by VS-5.
					Contact coarser grained: ALLUVIUM at 17.5 ft. bgs.	ST-6 TV= 0.15 Driller notes gravel/cobbles in borehole beginning at 17.5'
20	20.0					
	21.5	0.7	7-SS	14-17-13 (30)	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), gray brown with multi-colored gravels, wet, medium dense, approximately 25% sand, approximately 10-15% fines; gravel subangular to subround.	Switch over to HQ at 22 ft. Beginning at 16.48
25	27.0					
	28.5		8-SS	11-10-19 (29)	GRAVEL AND COBBLES) 0.7 up to 5-inches in size, Argillite and Quartzite, well rounded, approximately 30% sand, approximately 5-10% fines.	End Drilling 4/19/06 at 27.0'
	29.5					
30						

Begin Rock Coring at 30.0 ft below ground surface
See the next sheet for the rock core log

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW1-2	SHEET 2 OF 2

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation

LOCATION : South Side I-90 (986616.8 N, 872513.1 E)

ELEVATION : 3248.5 ft

DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : Burley 4500C - Barge, HWT Casing Adv. (HQ Rock Core)

WATER LEVELS : —

START : 4/19/2006

END : 4/20/2006

LOGGER : J. Butler, P.E.

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: RQD (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	GRAPHIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	Core Run #9-HQ Length 2.5 ft Recovery 80%	0	3	Fractures, 25 degrees - 40 degrees, rough ungulating to stepped, little to no infill, loose (<1 mm), countless		Contact ARGILLITE at 30.5', purple gray, moderately weathered, H=R2, R3.	
32.0			8				
	Core Run #10-HQ Length 5 ft Recovery 100%	58%	2	Fractures 10 degrees - 30 degrees, rough stepped to undulating.			
			2				
35			4			Better quality rock mass above 39 ft. than is typical other borings - less weathered, fractured.	
			>10				
37.0			3				
	Core Run #11-HQ Length 5 ft Recovery 96%	0	>10	Several healed fractures, tight.		Continued ARGILLITE, purple gray with more green streaks and layers below 39 ft.; R2 to R3 above 39; R1 below.	
			3				
40			>10			Below 39 ft. rock mass quality degrades - much more weathered and fractured, rock is nearly continuously fractured (most healed) and weathered along fractures.	
			>10				
42.0			>10				
				Bottom of hole at 42.0 ft. bgs.			
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW1-3 SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : Between I70 EB/WB, River Right (986570.1 N, 872439.6 E)

ELEVATION : 3250.0 ft — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500C - Barge, HWT Casing Adv. (HQ Rock Core)

WATER LEVELS : (submerged) — START : 4/19/2006 — END : 4/20/2006 — LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
						Cathead and rope safety hammer with 2 wraps around cathead (SPT 140#/30-inch)
	3.9					
5	5.0	0.6	1-SS	1-0-1 (1)	POORLY GRADED SAND (SP), gray, wet, very loose, homogenous.	Pool today elevation 3258.8 ft. (lowered to 1 feet for spillway survey).
	5.5					
	7.0	0.4	2-SS	1-1-2 (3)	Continued SP, similar to SS-1, except lower 0.2 ft is primarily wood chips.	
	8.8					Recovered a piece of leather on bit at 8.0 ft.
	9.2		3-VS			Bagged material stuck on vane, combo VS-3/VS-4.
	9.6					
10	10.0		4-VS			VS-3/VS-4 good tests, used medium vane (6.3x13cm).
	10.5					
	13.0	2.6	5-ST		Tip is SILTY SAND (SM), with a layer of dark gray LEAN CLAY (CL) in last 1/4 inch.	ST-5 good push, medium stiff.
	14.4	1.4	6-SS	3-46-50/5" (96/11")	SS-6 interbedded SM & CL upper 0.3 then 1.1 feet of Pine (a.k.a. wood).	
15	17.5					Had to switch over to HQ to get through wood to tight on casing. Wood identified as pinus ponderosa by team arborist M. Starling.
	19.0	0.8	7-SS	2-11-11 (22)	Core run to 17.5 encountered cobbles and gravel at 16.5 ft. maximum size 5 inches. SS-7 POORLY GRADED GRAVEL WITH SAND (GP), subrounded to well rounded gravel, fine and coarse, approximately 30-40% sand (ALLUVIUM).	
20						Backfilled borehole with bentonite chips (bags)
25						
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW2-1 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation

LOCATION : I-90 eastbound (986405.1 N, 872474.0 E)

ELEVATION : 3252.4 ft

DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged)

START : 4/20/2006 END : 4/25/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
2.0						
3.5	0.7	1	SS	16-21-11 (32)	POORLY-GRADED SAND with GRAVEL (SP), gray with multicolored pieces, wet, dense.	Driller notes soft muddy material in the first foot, then gravelly.
5						
7.0						
8.5	1.4	2	SS	1-0-0 (0)	LEAN CLAY (CL), gray, wet, soft, low to medium plasticity, some zones of high plasticity, homogeneous.	Driller notes softer at 4.5 ft. Depth to mudline below table (slipbox) = 15.0 ft Slipbox to pool = 4.2 ft 10.8 ft pool to mudline. SS-2 TV = 0.125 kg/cm^2 PP = 0.25, 0.25 tsf Driller notes firmer at 9.0 ft. Attempted vane at 9.5 ft, could not push, felt gravelly, some larger-sized particles (cobbles).
10						
12.0						
13.5	1.1	3	SS	8-20-25 (45)	POORLY-GRADED SAND with SILT and GRAVEL (SP-SM), gray, wet, dense, approximately 25 to 30 % gravel, approximately 15% fines.	Driller notes boulder (or large cobble) at 14.0 ft. Tightened up, switch over to HQ at 15.5 ft. Core to 18 ft (full stoke).
15						
19.0						
20.0	0.8	4	SS	11-11-17 (28)	POORLY-GRADED GRAVEL with SILT and SAND (GP-GM), gray, wet, medium dense, ~10% fines, ~30% sand. Begin Rock Coring at 20.0 ft below ground surface See the next sheet for the rock core log	End of drilling 4/20/06 At 19 ft. Resume drilling at 19 ft on 4/25/06.
20						
25						
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW2-1	SHEET 2 OF 3

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : I-90 eastbound (986405.1 N, 872474.0 E)

ELEVATION : 3252.433 — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged) — START : 4/20/2006 — END : 4/25/2006 — LOGGER : J. Butler, P.E.

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: RQD (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	GRAPHIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
5							
10							
15							
20	20.0						
	Core Run #5-HQ Length 1.5 ft Recovery 100%	0		Fractures, 10 to 25°, rough, undulating to stepped, tight.		Continued ALLUVIUM, gravel/cobbles/sand. Contact at 20.8 ft with ARGILLITE, purple-gray, finely bedded, moderately to highly weathered, weak to medium strong (R2-R3).	good fluid retention
	21						
	Core Run #6-HQ Length 2.5 ft Recovery 96%	60					
	24.0			24.4 to 24.6 ft, broken rubble zone, pieces 3/4" minus, clean.			
25				25.3 to 25.5 ft, broken rubbilized zone.		26.5 to 27.3: rock color change to light brown-gray, slightly less fractured.	
	Core Run #7-HQ Length 5 ft Recovery 98%	0		27.3 to 27.4 ft, joint, 25°, smooth to rough, undulating, clay infilling, 1/2-inch thickness, open.			
	29.0						
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW2-1	SHEET 3 OF 3

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation

LOCATION : I-90 eastbound (986405.1 N, 872474.0 E)

ELEVATION : 3252.433

DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged)

START : 4/20/2006

END : 4/25/2006

LOGGER : J. Butler, P.E.

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: RQD (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	GRAPHIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	Core Run #8-HQ Length 5 ft Recovery 102%	0		29.7 to 29.8 ft, broken rubbilized zone, 1/2" minus with some clay. Fractures 20 to 40°, smooth, planar to undulating, little or no infilling, tight.		Continued ARGILLITE, purple-gray, moderately weathered, weak to medium strong, fractures are prevalent throughout rock mass, although most are healed, porosity through rock must be high as water is retained in fractures after core dries at surface.	End Box 1 at 29.0 ft. Start Box 2 of 2. 10:58 11:02
34.0							
35							Backfilled with bentonite chips (3 bags).
40							
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW2-1B SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation

LOCATION : 8 ft upstream from SW2-1 (986410.7 N, 872480.6 E)

ELEVATION : 3253.9 ft

DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, HWT Casing Advancer

WATER LEVELS : (submerged)

START : 4/25/2006

END : 4/25/2006

LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5					Cobbles and Gravel. Sandier with Gravel.	Driller notes very gravelly/cobbly material upper 3 ft.
6.0						
7.5	1.5	1-SS	1-0-0 (0)		LEAN CLAY (CL), gray, wet, very soft, medium plasticity.	Driller notes softer material (possibly fine sand) at ~5.0 ft.
8.6						SS-1 TV = 0.25 kg/cm^2 PP = 0.25, 0.5, 0.25 kg/cm^2
9.0		2-VS	NA			VS-2: bagged some CL from vane.
10	2.0	3-ST	NA		Tip is LEAN CLAY with SAND (CL), gray-brown, wet, firm, low plasticity, ~10 to 15% very fine sand.	Tip of ST-3 slightly dented, sand/gravel at ~10.8 ft. ST-3: TV = 0.25 kg/cm^2 PP = 1.0, 1.0, 1.0 kg/cm^2
12.0						
12.5	0.1	4-SS	3-5-4 (9)		SS-4: recovered some coarse sand and fine gravel pieces.	SS-4 likely pushed coarse gravel in tip of shoe.
15						
20						
25						
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW2-2 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation LOCATION : (986470.2 N, 872627.8 E)

ELEVATION : 3255.5 ft DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, HQ Triple Tube Rock Core/HWT Casing Advancer

WATER LEVELS : — START : 4/16/2006 END : LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	2.0				Only about ~1 foot of riprap at surface	Cathead and rope safety hammer with 2 wraps around cathead (SPT 140#/30 inch)
	3.5	0.5	1-SS	5-4-8 (12)	POORLY-GRADED GRAVEL with SAND (GP), multicolored, wet, medium-dense, gravel well-rounded.	Riprap on slope is typically ≤1-foot, with some 2- and 3-footers.
5	7.5					
	9.0	0.2	2-SS	2-2-4 (6)	GRAVELLY LEAN CLAY (CL), dark gray, wet, firm, fine gravel, subrounded.	SS-2 must have pushed a gravel/cobble - low recovery
10	10.0					
	11.5	0.8	3-SS	13-16-7 (23)	POORLY-GRADED SAND with SILT and GRAVEL (SP-SM), dark gray, wet, medium dense, approximately 5% fines, approximately 20% gravel.	SS-3 used 3-inch spoon with rings
15	15.0					
	15.8	0.5	4-SS	30-75-/3"-(R) (9")	POORLY-GRADED GRAVEL with SAND and COBBLES (GP), gray with multicolored gravels, wet, very dense, approximately 20 to 25% sand, cobbles >3-inch size.	SS-4 used 3-inch spoon with rings End of drilling 4/16/06 at 17 ft. Switch over to HQ system. Driller notes consistent drilling in sand with few gravels.
20	22.0					
	23.5	0.6	5-SS	8-9-12 (21)	POORLY-GRADED SAND with GRAVEL (SP), gray, wet, medium dense, fine to coarse grained, approximately 15% fine, rounded gravel.	Depth to mudline from slipbox table = 12 ft. Depth to water surface below slipbox = 4.3 ft. Mudline is 7.7 ft below pool. Pool elevation = 3259.8 ft. SS-5 upper 0.3 is heave.
25	27.0					
	27.8	0.6	6-SS	25-50-/3"-(R) (9")	POORLY-GRADED SAND with GRAVEL (SP), similar to SS-5 except larger gravel pieces, 15 to 25%.	
					Begin Rock Coring at 27.8 ft below ground surface See the next sheet for the rock core log	
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW2-2	SHEET 2 OF 3

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986470.2 N, 872627.8 E)

ELEVATION : 3255.533 — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, HQ Triple Tube Rock Core/HWT Casing Advancer

WATER LEVELS : — START : 4/16/2006 END : LOGGER : J. Butler, P.E.

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	GRAPHIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
5							
10							
15							
20							
25							
27.8							
30	Core Run #7-HQ Length 2.2 ft Recovery 114%	0		Continued ALLUVIUM as POORLY GRADED GRAVEL with SAND (GP), gray with multicolored fine and coarse gravels, subrounded to well-rounded.		ARGILLITE, light gray-green to purple-gray, finely laminated, moderately to highly weathered, weak to medium strong (R2-R3).	14:26

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW2-2	SHEET 3 OF 3

ROCK CORE LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986470.2 N, 872627.8 E)

ELEVATION : 3255.533 — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, HQ Triple Tube Rock Core/HWT Casing Advancer

WATER LEVELS : — START : 4/16/2006 END : LOGGER : J. Butler, P.E.

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	GRAPHIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	Core Run #8-HQ Length 2.2 ft Recovery 100%	0					14:35
32.2							14:39
	Core Run #9-HQ Length 5 ft Recovery 100%	15%	8 5 7 4 7	Fracture, 5° (H) smooth to slickensided, undulating infilled with clay and calcite, open to loose. Fractures 10 to 45° (one that is predominantly vertical), smooth, undulating, typically no infilling material or surface staining, tight. Many healed fractures within rock mass. Fractures do not parallel bedding.		Continued ARGILLITE, light purple-gray to brown-gray, zones that are weak to very weak (R1-R2), predominantly R2. Rock mass Below 34.5 ft, rock is easily broken into 1.5-inch pieces with some cobble-sized pieces.	
35							
37.2							
	Core Run #10-HQ Length 5 ft Recovery 100%	40%	>10 >10 >10			Zone from 37.5 to 39.5 ft where rock is weathered into subangular 3/4-inch minus gravel.	End Box 1 at 37.2 ft, start Box 2 15:00 15:02
40						Better rock mass with less fracturing from 40 to 45 ft.	
42.2							15:14
	Core Run #11-HQ Length 4.8 ft Recovery 100%	28%					
45						45 to 47 ft, very fractured and weathered zone, rock easily broken into 1-inch minus pieces.	
47.0							Driller notes harder drilling (slower rate advancement) below 47 ft.
	Core Run #12-HQ Length 3.5 ft Recovery 100%	51%	5 0 3				
50							
50.5			7				
55							Backfilled boring with bentonite.
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW2-3 SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation

LOCATION : Between I-90 eastbound, westbound - river left (986444.5 N, 872561.1 E)

ELEVATION : 3252.0 ft

DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged)

START : 4/25/2006

END : 4/25/2006

LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5					Large boulders and cobbles.	Driller notes boulders at surface and at 3 ft, approximately 1-foot in size. Missed top of soft zone because of boulders pinching casing - estimate top of ~5 feet.
	6.3					
	6.7		1-VS	NA	Material on vane is a fine SILTY SAND (SM), brown, wet, approximately 40% fines.	VS-1: vane maxed out (used med. vane, 6.5 x 13 cm).
	6.5					
	7.5	1.0	2-DMS	3-6-14 (20)	DMS-2: interbedded LEAN CLAY (CL), SILTY SAND (SM), followed by CLAYEY GRAVEL (GC), brown CL/SM then black GC, wet, medium dense, few rootlets.	DMS-2: TV = 0.35 kg/cm^2 PP = 1.5 kg/cm^2 only bagged CL/SM portion.
	9.0				Estimated contact with gravel layer, GC, at ~7.0 ft.	
10		1.1	3-DMS	43-28-25 (53)	DMS-3: POORLY-GRADED GRAVEL (GP), very angular and broken up (large cobbles and gravels, mixed lithology), wet, very dense.	DMS-3: no sample retained.
	10.5				Bottom of hole at 10.5 bgs.	Backfilled borehole with bentonite chips (1 bag).
15						
20						
25						
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW3-1	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986744.1 N, 873316.7 E)

ELEVATION : 3258.0 ft — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged) — START : 4/14/2006 — END : 4/15/2006 — LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
						SPT with cathead and rope safety hammer, 2 wraps around cathead (140#/30")
	2.5					
	4.0	0.2	1-SS	5-4-2 (6)	POORLY-GRADED GRAVEL with SAND (GP), multicolored, loose, wet.	Pushed rock in spoon during SPT run SS-1 SS-1: no sample retained
5						From slipbox to mudline is 9.5 ft. From slipbox to pool surface is 4.2 ft. Mudline is 5.3 ft below pool
	7.5					
	9.0	1.5	2-SS	1-0-0 (0)	LEAN CLAY to LEAN CLAY with SAND (CL), brown to dark gray, wet, very soft, low plasticity, some small organics.	SS-2 PP = 0.75, 1.0, 1.0 tsf
10	10.0					
	12.5	2.4	3-ST	NA	Tip ST-3 is POORLY-GRADED SAND (SP), gray, fine-grained, above that is LEAN CLAY (CL) to SILT (ML), brown, wet, soft to firm, low plasticity.	ST-3 TV = 0.2 kg/cm^2 PP = 1.0, 1.0, 1.0 tsf
	14.0	1.2	4-SS	2-1-1 (2)	SS-4 continued interbedded ML/CL with some sandy and some organic layers, gray-brown to dark gray, wet, soft to firm.	SS-4 PP 0.75, 1.0, 1.0, 1.25 tsf
15	15.0					
	17.5	2.6	5-ST	NA	Tip of ST-5 is SILTY SAND (SM), brown, wet, stiff	ST-5 PP = 2.25, 2.25, 1.75, 2.5 tsf TV = 0.4 kg/cm^2
	19.0	0.7	6-SS	2-5-30 (35)	SS-6: SILTY SAND (SM) to SANDY SILT (ML) Contact alluvium at 18.5 ft. Alluvium is primarily COBBLES and GRAVEL, maximum particle size down to 24 ft is 0.8 ft, gravel and small cobbles are rounded to well-rounded.	SS-6: only recovered SM/ML Switched over to rock coring at 19.3 ft. Blocked off at 21, 22, 23, and 24 ft. End drilling 4/14 at 24.0 ft.
20						
	24.5					
25	25.1	0.5	7-SS	35-50/1"-(R)		SS-7: no sample retained rock (cobble) stuck in bit-advanced core barrel 24.5 to 29.5 ft: had to trip out (~15% recovery)
	29.5					
30						Backed off at 32, 32.5, 34, and 39 ft.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
342475.A1.01.T1	SW3-1	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : (986744.1 N, 873316.7 E)

ELEVATION : 3258.0 ft — DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged) — START : 4/14/2006 — END : 4/15/2006 — LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
31.0		0.8	8-SS	16-24-20 (44)	POORLY-GRADED GRAVEL with SAND (GP), red-brown, wet, dense, gravel subangular to well-rounded, ~20% sand. COBBLES in core run, 0.3 to 0.6 ft, estimated 10-15%.	
34.5						
35 — 35.6		0.5	9-SS	16-30-50/1" (R) (80/7")	POORLY-GRADED GRAVEL with SILT and SAND (GP-SM), red-brown, with green-gray gravel, wet, very dense, approximately 25% sand, ~5% fines.	Collected sample from good zone of recovery in core run.
37.0						
39.0		0.5	10-HQ	NA		
40 — 40.5		0.6	11-SS	19-12-10 (22)	POORLY-GRADED GRAVEL with CLAY and SAND and COBBLES (GP-GC), red-brown, wet, gravel rounded to subangular, approximately 5 to 10% clay, ~20% sand, cobbles up to 0.5 ft in size, mixed lithology. Bottom of hole @ 40.5' bgs.	15:00 Backfilled borehole with bentonite chips.
45						
50						
55						
60						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW3-2 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation LOCATION : (986799.6 N, 873390.7 E)

ELEVATION : 3255.4 ft DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged) START : 4/13/2006 END : 4/14/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
					Gravels and cobbles at mudline.	Depth to mudline below slipbox is 12.0 ft. Depth to water below slipbox is 4.2 ft. Mudline is 7.8 ft below pool. Driller notes softer material at 3.0 ft.
5	5.0					
	6.5	0.2	1-SS	1-2-3 (5)	GRAVELLY SILT (ML) to GRAVELLY LEAN CLAY (CL), brown-gray, wet, firm, low plasticity, interbedded.	SS-1: no sample retained, SPT pushed one coarse sized piece of gravel.
10	10.0					
	11.5	1.1	2-SS	2-1-1 (2)	POORLY-GRADED SAND (SP), upper 0.7 ft, then gradual transition to SILT (ML), SP brown-gray, wet, very loose, fine grained, ML brown, wet, soft, low plasticity.	SPT conducted with cathead and rope safety hammer (140 lb./30" drop). At 6.5 ft driller notes gravel/cobbles, size increasing below 7.5 ft. Driller notes softer at 9.5 ft.
	12.5					
	14.5	1.5	3-ST	NA	Tip of ST-3 is POORLY-GRADED SAND with SILT (SP-SM), ~5% fines.	SS-2 bagged SP (SS-2A) and ML (SS-2B) separately. 15:00
15	15.0					
	16.1	0.8	4-SS	17-43-50/1" (R) (93/7")	SS-4 is POORLY-GRADED GRAVEL with SAND (GP), multicolored alluvium, wet, very dense, gravel mostly fine, subrounded to well rounded, ~15% sand.	At 17.5 ft switched over to rock coring (HQ). Driller notes larger material.
20	22.0				17.5 to 22.0 recovered subangular to well rounded COBBLES with GRAVEL, mixed lithology, ranging in size from fine gravel to 0.9-ft cobbles.	
	22.3	0.2	5-SS	50/4" (R)-(R)		SS-5: no sample retained, blocked off at 21.0, 22.0, 24.5 ft, typical 60-100% recovery.
25	27.0					Pool elevation today is 3259.7 ft at dam, at 19:50 am. Blocked off at 26, 28, 32 ft.
	28.5	0.6	6-SS	15-23-28 (51)		
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW3-2 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation LOCATION : (986799.6 N, 873390.7 E)

ELEVATION : 3255.4 ft DRILLING CONTRACTOR : Crux Subsurface (Mike Starling)

DRILLING METHOD AND EQUIPMENT : Burley 4500 Componentized, Core/HWT Casing Advancer

WATER LEVELS : (submerged) START : 4/13/2006 END : 4/14/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
32.0						
32.2	0.0	7-SS		50/2"-(R) (50/2")	Continued mixed lithology, POORLY-GRADED GRAVEL (GP) and COBBLES, from 32 to 34.5 ft is one boulder, 1.1 ft in diameter, angular, gravels mostly well rounded, estimate ~10% boulders, ~25 to 40% cobbles, ~40 to 50% gravel, alluvium also contains some fraction of sand although quantity is unknown.	Recovered <0.5 ft from 28 to 30 ft. SS-7: no sample collected. Blocked off at 34.5, 36, 37 ft.
35						
37.0						
	0.2	8-SS		9-15-12 (27)		SS-8 also bagged some of the core run.
38.5					Bottom of hole at 38.5' bgs.	Pulled all HQ out and taped hole, stayed open down to ~36 ft. Backfilled borehole with bentonite chips.
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CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW4-1 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation — LOCATION : South side, west end SH Zoo Bridge (986980.5 N, 873144.3 E)

ELEVATION : 3261.2 ft — DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/31/2006 END : 3/31/2006 LOGGER : G. Warren

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	0.5					
	2.5	2.0	1-ST			
	3.0					
	4.5	1.3	2-SS	0-0-1 (1)	SILT (ML), brown, moist, soft, low plasticity, 10% clay.	TV = 0.15
5	5.0					
	7.0	1.5	3-ST		SILT (ML), with interbedded Clay and Silty Sand sections, brown, moist, very soft, organic wood chips at tip.	DP = 0.75 x 3
					TIP: leaves, organics.	No TV = Tip is all leafy organics
10	10.0					
	11.5	1.5	4-SS	1-1-1 (2)	SILTY SAND (SM), Poorly-Graded Sand, brown, wet, very loose, fine-grained, est. 20%-40% Silt.	
					Gravel at 12'.	Very slow augering in gravel.
15	15.0					
	16.5	0.7	5-SS	8-10-9 (19)	POORLY GRADED GRAVEL (GP), purple with yellow mottling, moist, medium dense, 1" minus, subround to subangular, yellow clayey matrix.	Refusal at 15'; move 3 times, on 4th try get deeper.
20	20.0					
	21.5	0.8	6-SS	35-12-17 (29)	SILTY GRAVEL (GM), brown, wet, medium dense, 1" minus, round to subangular, silty matrix, very wet.	Driller estimates cobbles and boulders.
25	25.0					
	26.5	0.9	7-SS	60-31-34 (65)	SILTY GRAVEL (GM), purple, wet, very dense, 1" minus, mixed lithology, subround to angular, silty matrix.	
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW4-1 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation

LOCATION : South side, west end SH Zoo Bridge (986980.5 N, 873144.3 E)

ELEVATION : 3261.2 ft

DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : —

START : 3/31/2006

END : 3/31/2006

LOGGER : G. Warren

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30.0						
	30.0 – 31.5	0.5	8-SS	5-17-42 (59)	SANDY/SILTY GRAVEL (GP-GM), purple-gray, wet, very dense, round to subangular, mixed lithology, 30% Silty Sand matrix, 1.5" minus.	Cobbles, slow augering.
35	35.0 – 36.5	0.1	9-SS	16-13-16 (29)	POORLY GRADED GRAVEL (GP), gray, wet, dense, 1.5" minus size to 1/4", subround to broken angular fragments, trace silt, mixed lithology.	
40	40.0 – 41.5	0.5	10-SS	14-27-26 (53)	SILTY GRAVEL (GM), gray and maroon, wet, very dense, broken angular fragments, 10% Sand and Silt matrix.	T.D. 41.5'
45						
50						
55						
60						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW4-2 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation LOCATION : (987040.2 N, 873271.5 E)

ELEVATION : 3262.0 ft DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/23/2006 END : 3/23/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
						CME Autohammer used for SPT (140#)
5	5.0					
	6.5	0.6	1-SS	2-2-2 (4)	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), brown-red to gray, moist to wet, loose, approx. 40-50% fine gravel, 35-40% sand - 10% or less fines [FILL].	
10	10.0					Driller notes harder material after 9.0 feet.
	11.5	0.5	2-SS	6-5-1 (6)	MIXED POORLY GRADED GRAVEL (GP), some Sandy layers, and one 0.2-foot thick layer of SILT (ML), dark brown, wet, loose/firm, [FILL and some RES. Sediments]	
15	15.0					
	16.5	0.7	3-SS	7-10-31 (41)	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), brown, wet, dense, sand subrounded, approximately 25% gravel, 10% fines, pieces of broken argillite on top (0.1 feet).	Very hard, slow drilling, (rock), driller thinks possibly large boulders.
20	20.0					
	21.5	0.6	4-SS	18-15-13 (28)	POORLY GRADED GRAVEL (GP), green/red, wet, medium dense, subangular to well-rounded [ALLUVIUM].	
25	25.0					
	26.5	0.6	5-SS	7-13-24 (37)	Continued GP, gray-red, wet, similar to SS-4, dense.	
30						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
342475.A1.01.T1	SW4-2 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Milltown Bridge Infrasture Mitigation LOCATION : (987040.2 N, 873271.5 E)

ELEVATION : 3262.0 ft DRILLING CONTRACTOR : HAZ TECH Drilling

DRILLING METHOD AND EQUIPMENT : H.S.A. CME 850 Track Mounted

WATER LEVELS : — START : 3/23/2006 END : 3/23/2006 LOGGER : J. Butler

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	30.0					
	31.5	0.6	6-SS	9-12-17 (29)	POORLY GRADED GRAVEL (GP), gray to reddish gray, wet, medium dense, approximately 15% Sand.	
35	35.0					
	36.5	0.6	7-SS	9-18-27 (45)	Continued GP, similar to SS-6, except dense.	
40	40.0					
	41.5	0.6	8-SS	13-29-50/3.5" (79/9.5")	Continued GP, similar to SS-7, except very dense.	Bottom of hole 41.3 ft. bgs. Backfilled boring with bentonite chips.
45						
50						
55						
60						